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CRAFTING STORIES THROUGH PLAY

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Abstract

Crafting Stories Through Play

by Ben Samuel

This dissertation explores the notion of shared authorship in interactive narratives and computational media. A work of shared authorship is one in which the player and the system collaboratively create a narrative artifact, ideally one which neither would have been capable of producing on their own. This is in contrast to many works of interactive narrative, which ship with either a single story or a relatively small number of stories for the player to experience through gameplay.

After introducing the notion and pleasures of shared authorship, this document discusses many fields of research relevant to this particular brand of interactive storytelling, including sculptural fiction, story generators, and player modeling. It also borrows theory from the humanities—with particular emphasis on Brechtian and improvisational theatre—to help further discover possible avenues and ideal qualities pieces of shared authorship should possess. This section then ends with a discussion of several existing games with narrative elements and varying degrees of collaboration, and proposes several dimensions with which to measure them, in the hope of discovering as of yet unexplored shared authorship design space.

The dissertation then goes into its first of three examinations of a playable shared authorship experience enabled by new artificial intelligence technology: *Prom Week*. Over the course of three chapters, *Prom Week* is examined in three different ways:

through the underlying technology that enabled it, though the playable experience itself, and through a variety of novel evaluation mechanisms. Throughout each of these explorations, the systems are discussed through a lens of shared authorship; their successes and failures at being works of shared authorship in and of themselves, and their potential for creating and inspiring works of shared authorship in the future. This pattern is repeated two more times with the playable experiences of *Bad News* and the in-development *Writing Buddy*.

Though there is still much design space yet to be explored, *Prom Week*, *Bad News*, and *Writing Buddy* nevertheless manage to be notable advances in the cause of shared authorship.

Acknowledgments

My first acknowledgment is one of my many shortcomings: that I have, for the greater part of my life, not paid much attention to the acknowledgment sections of books, dissertations, or the like. Oh, sure, I would skim the occasional dedication page, as it warms the heart to imagine the stalwart author thanking their sympathetic spouse or beautiful children for giving them the support they needed to push through and create. But acknowledgments pages were just a list of names either devoid of meaning, or so full of fame that I knew that they would never impact me.

However, as I've grown older, if not wiser, I've learned to appreciate the acknowledgments section for what it truly is: an opportunity to see the web of influence that connects us all from a clear vantage point. This section is a birds-eye-view of a few of the kind, gracious souls that deeply influenced me, my work, and my thinking. And if you were to go and read all of *their* acknowledgments sections, you would by and large discover a new set of folks that influenced them, who vicariously influenced me through our mutual acquaintance. It is a small miracle whenever anything gets made, and these miracles can not help but be filled with a vast amount of influences. To that end, let's start naming some names.

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Chapter 1

Introduction to Shared Authorship

You've decided to pick up this dissertation! Hooray! I thank you for your curiosity, and have retroactively been justified in including you in the acknowledgments section (it's true, go take a look!) Now, I can only imagine that the question at the top of your mind is something along the lines of what, exactly, do I mean by shared authorship?

Well, it may be a little difficult to explain. It may, in fact, take me the next several hundred pages to do so. But the basic premise isn't that hard to describe, so let's start there:

Shared authorship is the act of creating something with someone else that could not have existed without the both of you.

My dissertation will reify and expand upon this definition in great depth. In the cause of doing so, I will be primarily addressing two research questions:

(1) Can a space of shared authorship dimensions be defined that describes existing works and reveals new design directions?

(2) What technologies need to be developed to move in these new design directions, and what new experiences do they enable?

Chapters 1, 2 and 3 will address the first question by providing the reader with a deeper understanding of the phenomenon of shared authorship. Chapters 4, 5, 6, 7 and 8 address the second by describing several works made by myself (alongside several colleagues) that the first part of the dissertation show to be prime examples of the form.

Specifically, chapter 1 motivates the work by disentangling the notion of shared authorship from the broader term of interactive storytelling by introducing key terms through a few example story-based games and presenting qualities that shared authorship games exhibit in the form of pleasures. Chapter 2 specifically focuses on a description of existing technologies and philosophies—spanning both computer science and theatre arts—that could potentially be applied towards the cause of shared authorship. Chapter 3 takes the established pleasures, technologies, and philosophies and—through examining a collection of interactive narrative experiences that demonstrate a range of those qualities—proposes a set of eleven axes, or design dimensions, with which one could chart a piece of shared authorship. The chapter concludes with the happy result that several technologies I have helped to develop—and pieces powered by said technologies I have developed as well—exhibit qualities of shared authorship. The remainder of the dissertation address my second research question through a discussion of the technical details of these systems, and how they succeed (and, at times, fail) as pieces of shared authorship.

Pieces of shared authorship, as will be discussed in more detail subsequently, must be examined from several angles to be truly understood: the relationship the creator has with the piece (that is, the initial creation process) speaks to the space of artifacts the piece is capable of producing, the process of a player (or user) engaging with the piece and producing said artifacts speaks towards the piece's capacity to be a good collaborator, and the artifacts themselves—and the player/user's attitudes towards them—reveal the level of ownership felt over the process. Many existing works, games, and practices share varying amounts of these qualities; the eleven axes proposed are meant to more formally describe these processes, and in so doing reify the very notion of shared authorship. Although I will cover these axes in depth in chapter 3.2, the names of these axes are descriptive enough that introducing them now will—I believe—properly frame the reader's thoughts as they continue reading from here.

My eleven axes of shared authorship are: *Direct Human Collaboration*, *Collaborator Performance Capability*, *Level of Immersion*, *Level of Simulation*, *Distinct Producible Play Traces*, *Visibility of the Collaborator*, *Reliability of the Collaborator*, *Number of Distinct Game States*, *Wide Possibility Space and Convergence*, *Visibility of Story State*, and *Cohesion of Finished Product.*

Before expanding on those, however, I believe it will aid the reader in understanding the notion of shared authorship—as well as provide some useful context for a discussion of interactive works—by first discussing several terms frequently associated with interactive storytelling, including interactivity (and indeed, the term interactive narrative itself, see section 1.1.1) and agency (see section 1.1.2). Then, to further motivate my research, I'll discuss in section 1.2 seven pleasures I have identified that engaging with works of shared authorship can activate.

1.1 Shared Authorship Through Examples

Though I alluded to this in the prior paragraphs, this dissertation is going to be discussing shared authorship through the lens of interactive, playable experiences or—more colloquially—games. Speaking of which, I think looking at a few examples of games might help draw out some of the particular differences I hope to bring to light through my examination of pieces of shared authorship. The first game I'd like to discuss is one of my favorite games of all time, LucasArts' classic graphic adventure game *The Secret of Monkey Island* [85].

1.1.1 The Secret of Monkey Island and Interactive(?) Narrative

Let us first make sure that we are on the same page regarding a few key terms of interactive storytelling, including interactivity and interactive narrative. I think a fine game to center this conversation around is *The Secret of Monkey Island*. If you have not played *The Secret of Monkey Island*, I really cannot impress upon you enough how you should stop reading this right now to go enjoy it. Mostly this is because it is a wonderful game; partly because I am about to spoil its plot. In it, players assume the role of the hapless Guybrush Threepwood, a young man who dreams of becoming a pirate. He journeys to Mêlée Island, where three venerated pirate masters explain that to become a pirate one must overcome three trials. While proving himself as a thief, sword-fighter, and treasure-hunter, Guybrush falls in love with the quick-witted Governor of Mêlée Island, Elaine Marley, and learns that the dastardly Ghost Pirate LeChuck has been terrorizing the Caribbean. Just as Guybrush completes his trials, LeChuck captures Elaine and takes her to his stronghold on the eponymous Monkey Island. Frantic to rescue her, Guybrush assembles a crew, makes the harrowing journey to Monkey Island, matches wits with cannibals, befriends an odd hermit, navigates a subterranean hellscape with the aide of a preserved head, and ultimately makes his way back to Mêlée to stop Elaine's forced marriage to LeChuck and do battle with his spectral nemesis.

Armed with this overall description of the game, I ask you, gentle reader, is *Monkey Island* a work of interactive narrative? The game clearly has a story to tell. It is full of brilliant quips and strong writing. It has memorable characters with clear objectives, it has a beginning, middle, and end, and it follows the rough structure of the hero's journey. Hopefully no one will quibble over the claim that *Monkey Island* is a work in which narrative plays a central part.

It also seems fairly safe to say that the game is interactive. Let's think of interactivity in terms of Chris Crawford's Listen-Think-Speak loop [49][1]. In this loop, we think of

[1]It is important to note that the example that follows uses a rather simplistic model of communication, assuming that interlocutors are engaged in a process of turn-taking where both participants alternate between acting and reacting. As discussed in Suchman's *Plans and Situated Actions* [283], "analyses of face-to-face communication indicate, then, that conversation is ... a joint action accomplished through the participants' continuous engagement in speaking and listening." Regardless, I find Crawford's metaphor to be a useful one for describing the notion of interaction.

both player and system as interlocutors in a conversation; one party *listens* to what the other is saying, *thinks* on what they've heard, and then *speaks*, their response. The other party responds through a similar pattern, and the loop is formed. Of course, when the "conversation" is between a player and the game, "speaking" often takes the form of mouse clicks and keyboard strokes for the player, while the computer relies on visual updates through a monitor and audio beeps and boops through speakers, but the metaphor of conversation is still apt. Given this metaphor, it becomes readily apparent that *Monkey Island* is, at least to some extent, interactive. The player *speaks* their commands through clicking on interface elements in the game world (typically a *verb* such as open, pick-up, or talk-to, followed by the subject the player wishes to apply the verb to), the system *listens* to the parts of the screen that were clicked so that it knows the verb and subject the player specified, it *thinks* about what should happen given that input (more often than not determining that Guybrush should say a line about how he can't take that particular action), and then *speaks* that result to the screen (Guybrush will start moving his mouth and the line of dialogue selected will appear above his head). The player *listens* to this result (admittedly perhaps more with their eyes than ears), *thinks* about what to try next, and then *speaks* their next command again through clicking on more interface elements. We have, once again, achieved a communicative loop and consequently interactivity.

But perhaps an even more straightforward way of thinking about all of the above is to simply start the game and see what happens when the player abstains from the duties their title confers. If the player does not play, then nothing happens. Guybrush will happily stand on the docks of Mêlée Island for a seeming eternity. Progress in the game only transpires when the player takes an active role. Thus *Monkey Island* can be described as a piece of ergodic literature [1], as one must actively work towards making narrative progress.

We have, then, a game in which the narrative plays a tremendous part, and which only progresses when the player opts to interact with it. It seems, by all measures, that this should be considered a prime example of interactive narrative. And yet, I still find it to be a misnomer to refer to *The Secret of Monkey Island* as such. The reason being that, though the narrative requires interaction in order to progress, the narrative itself is static and unchanging. The synopsis provided above is not just a description of my personal playthrough of the game; it is the synopsis of the game itself, and will apply to every player's experience. There is, of course, some room for variation. The order in which certain puzzles are solved allows for some flexibility, for example. When assembling Guybrush's pirate crew, the player can choose to recruit his band in any order. However, the only citizens of Mêlée that will ever acquiesce to this call to adventure are Otis the thief, Carla the swordmaster, and Meathook the tour-guide/tattoo-showman. The order in which they are approached may be left to the player, but all three of them must be won over before the plot may continue. Moreover, they can only be recruited at a very specific point in the game (the second half of *Part I: The Three Trials*, to be precise). It is also worth mentioning that the sequence of steps that Guybrush must follow in order to recruit each of them is unchanging from game to game; the same puzzles are always encountered, each puzzle only has a single solution, and that solution will always have the same outcome. This is not isolated to just this part of the game; completing the three trials, getting to—and escaping from—Monkey Island, and the final showdown with LeChuck all follow similar patterns.

The narrative is pre-written. Its constituent stuff—the overall structure of the plot, the dialogue spoken by the characters, the solutions to puzzles, and the puzzles themselves—were all conceived by game designers and writers. All of this content is burned to disc, waiting to be unwrapped (okay, okay, downloaded) and experienced by players. Though the narrative will not advance unless the player interacts with it, the player has no choice but to consume content which has already been created. Delicious though this content may be, it doesn't adhere to the definition of shared authorship laid out above: the content of *The Secret of Monkey Island* exists just fine without you. The fact that you need to interact with it in order to progress is irrelevant; one needs to interact with a book in order to read its content as well, but your engagement with the book will have no bearing on its content.

Already we have arrived at an important takeaway for pieces of shared authorship: the story cannot be pre-written ahead of time, but rather must be capable of dynamically adapting to the actions of the player. Does one need to have this same ability to alter the shape and course of the narrative itself for a work to be considered a piece of interactive narrative? Perhaps not, since as described above I believe *Monkey Island* is often considered an interactive story. But what if we come at it from the other direction? Does having the ability to alter the shape and course of the narrative automatically make something a work of shared authorship? Let us examine two more examples of games that might help to answer this question.

1.1.2 *Quest for Glory*, *Mass Effect*, and Agency

To help further define what makes something a work of shared authorship, I'd like to take a moment to discuss two other games: the grand space opera role playing game *Mass Effect* [17] by Bioware Entertainment, and another point-and-click graphic adventure game: *Quest for Glory 1: So You Want to be a Hero* [39], by Sierra On-Line. I'll be looking at these games as examples of interactive narratives which provide the player the capacity to alter the course of the story through play—and as a vehicle to introduce the term agency, an important notion for interactive experiences—which will then permit further discussion on how shared authorship fits into a larger dialogue of interactive storytelling.

Without going into too much detail, *Quest for Glory* has players assume control over a recent graduate of the Famous Adventurer's Correspondence School as they first arrive at Spielburg Valley, a land replete with Germanic folk and fairy tale influence, to locate the Baron's missing children, put a stop to some brigands, and convince the witch Baba Yaga (visiting from her Slavic origins) to pack up and leave.

Gameplay feels very similar to *Monkey Island*: the world is full of people to speak with and objects to collect, and the story is primarily advanced through solving puzzles. However, unlike *Monkey Island*, many puzzles have multiple solutions, typically with a rough correspondence to what class you choose for your adventurer at the beginning of the game; fighter, magic user, or thief. Does this mean that *Quest for Glory* counts as a piece of interactive narrative while *Monkey Island* might not? Although notions such as interactivity and narrative are difficult to measure precisely, the listen-think-speak loop for the two games are nearly identical, implying similar levels of interactivity. And though the narrative set pieces of the two games differ greatly, they both tell a similar tale of a young unknown proving their mettle to save a terrorized populace. How, then, can it be expressed that *Quest for Glory* puzzles have alternative solutions, and thus provide the player with the ability to better role-play their specific character?

One helpful way to think about this is through the metaphor of the String of Beads [95]. In this metaphor, each bead represents a localized area of player choice. In *The Secret of Monkey Island*, for example, the second half of part I, in which Guybrush assembles his crew, might be considered to be a single bead. Inside of this bead the player has influence over localized narrative structure; as discussed above, the player can choose who to recruit first, among other decisions.

But, as can be seen in figure 1.1, these localized bits of player choice are not utilized by the system to either form or present additional narrative aspects once the player has progressed to the next bead. The next bead is reached when certain narrative requirements are met (in this case, when both crew and ship have been safely secured), and any of the different choices made by different players leading up to the moment are now completely forgotten by the game, and all players begin their next bead in the exact same way. The player's choices have been obviated.

Quest for Glory follows a similar, yet slightly different, pattern. Its "beads" represent not parts but puzzles. Like figure 1.1, each individual puzzle does not take into account

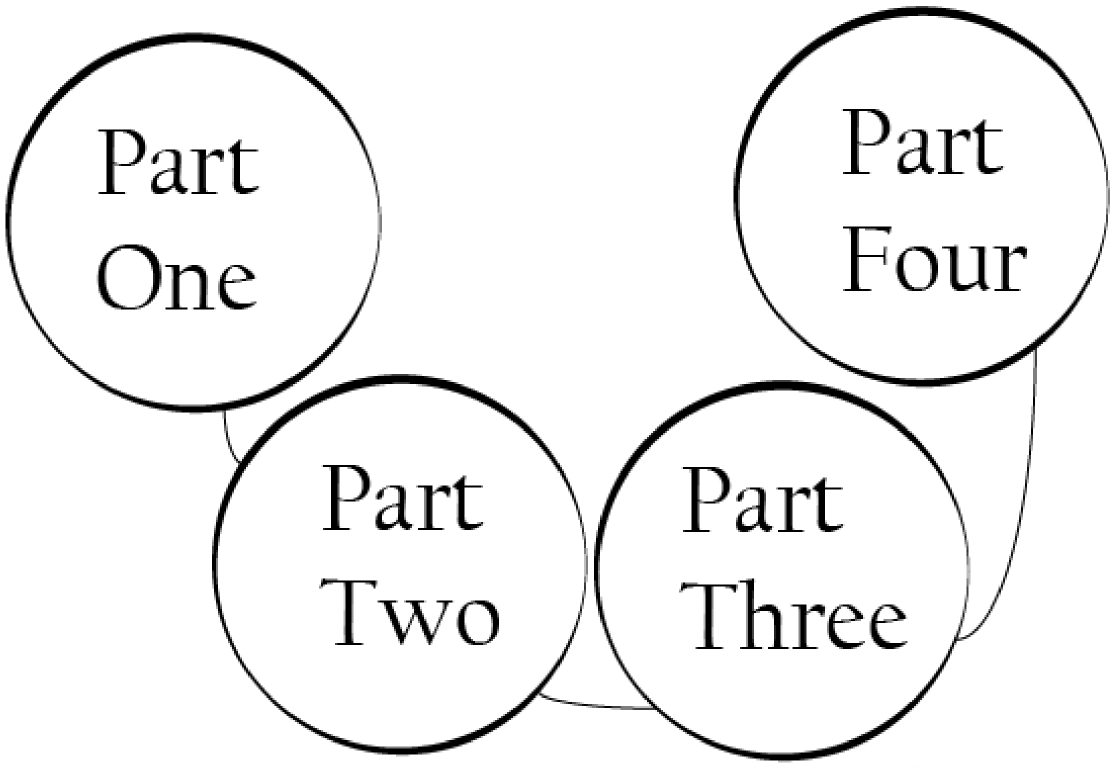

Figure 1.1: The Bead of Strings for The Secret of Monkey Island. Any given bead represents one of the four "parts" of the game. Though there is room for variation of player performance within a bead, there exists only one set of solutions for the puzzles, and thus only one way to progress from part to part. The player's actions in any given part have little to no bearing on the others.

the choices made in other puzzles. However, the game affords more flexibility in the order in which the player tackles the game's major plot points, as well as there being multiple solutions to most of the puzzles. This means that there are essentially multiple ways to travel from one bead to the next. For example, an early quest in the game involves retrieving a lost ring, tucked away in a bird's nest on a tree branch. Players who opted to make their character a fighter can throw pebbles at the nest until a lucky strike and a bit of gravity brings the ring to earth. Thieves can climb the tree to pluck the ring directly from the nest, and magic-users can cast a specific spell to fetch the ring to them directly. Once the user has the ring, they have now effectively moved on to the next bead, and the route they took to get there is now moot. Still, it proves to be an example of the game providing the player an opportunity to advance the narrative in one of a variety of ways. Thus, though not structurally that different than *Monkey Island*, the player's interactions *will* shape the course of the narrative. If we think of interactive narrative as a spectrum, with works either affording more or less means to actually interact with the narrative itself, *Quest for Glory* would score higher than *Monkey Island*.

However, it would not be too much higher. Though these multiple paths exist, the fact remains that they were—as with *Monkey Island*—all conceived long before the game ever made its way into the hands of players. The player is simply choosing one of a small handful of ways to progress through the narrative, but as before they are not creating something that couldn't have existed without them. As satisfying as choosing how to solve a puzzle might be, it is still ultimately an act of selection over existing content, rather than creation.

Let us now take a moment to talk about the *Mass Effect* series. This trilogy of games follows the exploits of Commander Shepard as he/she (players are given the ability to select Shepard's gender at the game's onset) explores the galaxy to defeat rogue agents, terrorist organizations, and ancient life-eradicating spaceships. During dialogue with the game's many NPCs, players are often presented with opportunities to choose Shepard's moral stance. Shepard interacts with all sorts in their travels across the cosmos, and players can decide—often multiple times in the course of a single conversation—if they wish to respond in a friendly, supportive way (being a Paragon, in the game's parlance), or in a grouchy, self-centered one (being a Renegade). As the player makes these choices, they build up a running score of Paragon and Renegade points that enable Shepard to be even more selfless—or even more grouchy—than could have ever been thought possible. In addition to these choices, there are other major choice points throughout the game in which the player must make irreversible decisions. One of the most memorable of these events involves a friend and crew-mate, Wrex, suddenly having doubts about destroying an enemy facility, as it may contain the cure to his species' forced sterilization. Once these doubts are expressed, another friend and crew-mate suddenly has doubts about Wrex's loyalty, and offers to shoot him on the spot. Wrex's life is in the player's hands; if he is killed, he'll be dead not only for the remainder of the player's game, but will be absent for the entirety of the player's journey through the series.

Here, the player is not only advancing the plot through interaction (as they were doing in *Monkey Island*), nor are there simply multiple solutions to puzzles which are then immediately forgotten (as was the case in *Quest for Glory*). The player is making lasting choices that significantly impact the course of the narrative. However, two niggling details remain.

The first is the exact same issue that arose with our two graphic adventure games: once again, the player is merely selecting from pre-written content. The number of paths for the player to choose from is substantially greater in *Mass Effect* than in *The Secret of Monkey Island* or *Quest for Glory*, but they remain paths that were developed by the creators of the game[2]. There are enough of these paths that two players reflecting on their respective playthroughs with one another might be surprised over the ways in which the narrative diverged; they might feel a sense of ownership over their particular playthrough; that their playthrough is an expression of themselves, their values, and their interests. But though the playthrough may feel personally meaningful to that player, it was a playthrough of their choosing, rather than an act of creation. And given the fact that the *Mass Effect* series were AAA titles which sold millions of copies, there are enough players playing the game that chances are that as unique as any given playthrough might feel, there are many others who experienced a near identical one.

Whether the plot and narrative is being impacted or not is not up for debate here. The personality of the main character, the fortunes of their friends, and the fate of the Universe are all impacted by the player's decisions. In Marie Laure-Ryan's terms, players of digital narrative experiences can have a relationship to the story that ranges from "exploratory" to "ontological." [242]. An exploratory relationship indicates that the narrative itself is static. In exploratory narratives, the player may have power to adjust the order in which they experience certain narrative beats or skip certain ones entirely (not unlike sequencing the order Guybrush broaches dialogue topics in *The Secret of Monkey Island*), but the story itself is cast in stone (not unlike *The Secret of Monkey Island* in general). Pieces in which the player has an ontological mode of interaction enable them to actually enact change on the details of the narrative. Given

[2] Please note that here I am specifically referring to *Mass Effect*'s narrative. The game also has combat, and systems related to it (e.g., accruing experience points, leveling characters up, and augmenting combat prowess with new skills), which are very dynamic. In this aspect, the game gives players something other than a choice between pre-written paths.

this understanding, it feels safe to say that *Mass Effect* provides its players with an ontological mode of interaction.

In truth, the exploratory/ontological binary is a spectrum. Though *Mass Effect* affords many more opportunities for ontological engagement, even *Monkey Island* provides a few moments of lighthearted impact. A memorable depiction of one such moment is a short scene during the game's epilogue, featuring Guybrush's crew impatiently awaiting rescue. This only plays if the player had catapulted a rock into their own ship during Part 3. Ryan also introduces the notion of players/readers having an internal vs. external mode of engagement with a narrative. In both *Monkey Island* and *Mass Effect*, players have an internal mode of interaction as they are represented by a character within the game's diegetic universe. External modes of interaction are probably best represented by early hypertext work, but is also present in recent-as-of-this writing works such as navigating the branching story structures of *Virtue's Last Reward* [303], or in pieces authored in Twine [117]. In the case of *Monkey Island*, having an internal representation enacting changes in the world (sword fighting with insults, traversing chasms with rubber chickens with pulleys in the middle, etc.) feels ontological as the player is directly impacting the game world through manipulating Guybrush. It is only through the player's actions that Guybrush will quip about dairy farmers and use rubber chickens, after all. The compromise seems to be that it is possible to have an ontological impact on the game world without having the capacity to make an ontological impact on the narrative.

In works of shared authorship, players have an immensely ontological impact on the narrative, as key aspects of it—such as the characters present and the actions they take—may be entirely missing until the player determines them through play. Thus, though the notion of having an ontological impact on a narrative is a useful lens through which to view works of shared authorship, having an ontological impact alone isn't sufficient to qualify a work as a piece of shared authorship. This discussion of the player's ability to impact the game world and narrative might remind readers of another concept pertaining to the player's ability to manipulate virtual words: the notion of agency.

The term agency is a loaded one, as it has been used by many researchers in many different contexts. My favorite definition of agency was introduced to me by Michael Mateas, which has an intellectual heritage in the writings of Janet Murray and Brenda Laurel [139, 177, 120]. The heart of this definition depends on the idea that a game consists of formal and material affordances. The formal affordances of a game are the actions, behaviors, and means of performance that the game world evokes in the mind of the player. When a player approaches a game, they bring with them an entire lifetime of associations and beliefs. This means that when players encounter objects and situations in game, the objects themselves will "cry out" how they want to be used. Barring any extenuating context, if a player sees a mailbox in-game, they will imbue it with all of the affordances of a real-world mailbox. It can be opened and closed, mail can be inserted into it, and its flag can be raised or lowered. Formal affordances can transcend associations with individual objects as well, elevated to the level of game level actions. For example, when playing a detective game, players might imagine the formal affordances of exploring crime scenes, interrogating witnesses, and wearing fedoras. If the game sparks the player's imagination—be it through its objects, setting, or the marketing copy on the back of the box—into believing that something should be possible, then that is considered a formal affordance.

A material affordance, then, is what is actually possible to carry out in the game world. Can the mailbox be opened and filled? The flag lifted? Can the player interrogate witnesses and look good doing it? A game is said to have high agency when the material and formal affordances are in balance; when the game allows the player to carry out that which it suggests should be possible. A game with more formal affordances than material feels limiting, as the player envisions taking actions that the game does permit. Conversely, a game with more material affordances than formal can be confusing, as the player is capable of taking actions for which they have no frame of reference for their meaning.

I also find it interesting to note that the balance does not speak to the quantity of affordances present. The classic example of a high agency game is a first person shooter such as *Doom* [30]. This game has a relatively small amount of formal affordances; there are corridors to explore, locked doors, and an army of demons hunting the player down. Fortunately, the game provides the player with the gift of movement, keys to acquire, and an arsenal of weapons. The game might not ask the player to conceive of much, but that which they can conceive they can carry out, and in great measure[3].

[3] It is worth noting that, as Wardrip-Fruin, Mateas, Dow, and Sali do in Agency Reconsidered [310], the only things that can be made possible are those which have logics to support them. *Doom* makes use of spatial and inventory logics—well trod territory present in a great many video games. This speaks of the importance of research like mine, which attempts to expand what interactive narratives that offer

Agency, broadly speaking, is a good thing to be aiming for in games, as the affordances being out of balance can lead to frustration and confusion, as mentioned above. However, depending on the aesthetic experience a game developer is hoping to achieve, limiting the amount of agency could be done as an intentional design choice. Agency plays an interesting role in a work of shared authorship, because it is important that there exists a collaborator figure taking part in the authoring process as well. For that collaborator to be considered an author, they must have some amount of agency themselves. Now the player's agency is being assaulted on two fronts! Not only might the game itself lack a perfect balance of material and formal affordances (most games do), but now the player's actions are being made in concert with another! The other entity might very well take the story being authored in directions the player was not expecting, or perhaps actively attempting to avoid altogether. Though this has the ring of truth to it, I believe this line of thought might be doing shared authorship a disservice.

For a moment, let us imagine a competitive game, in which two players are actively working against each other in their bid for victory. For the purposes of this argument the specific game chosen does not matter. Let us go with *Checkers*. In a game of *Checkers*, does one's opponent limit one's agency? If the opponent is doing their job, they will be removing the player's pieces from the board, limiting the total possibility space of moves available. That looks like a reduction of agency! Ah, but just because it looks like a reduction of agency, does not mean it quacks like one. Having pieces taken away reduces the player's amount of material affordances, but it is unlikely that the player

an experience of agency are even capable of addressing.

will hold on to the formal affordances of moving pieces that no longer belong to them. That is to say, the formal and material affordances are being reduced at a relatively equal rate, and thus the agency balance is preserved.

To continue the reversal even further, I think having an opponent can actually increase the agency. The avid *Checkers* player undoubtedly entertains fantasies of making a brilliant move that enables them to capture many of their opponent's pieces in a single strike. In order for that fantasy to come to pass, though, the opponent must be making moves of their own. It is only through the agency of our rival that our own agency truly comes to light. Our *Checkers* example is simply an analog counterpart to the demons in *Doom*: the context of the game depends heavily on the player's engagement with antagonistic forces. To remove them would not increase the player's agency, but reshape the game into something entirely unrecognizable.

Similarly, the give and take in a shared authorship experience is central to its identity. Rather than viewing the creative input of the collaborator in a limiting light, engaging with and influencing that creative input becomes an avenue for agency in its own right. When analyzing works of shared authorship through the lens of agency, one can ask additional questions to the ones asked in a standard piece of interactive storytelling. That is to say, in addition to examining the agency involved in the story that was constructed, it becomes possible to look at the agency present in the story's construction *process*, with particular regards towards its collaborative nature. What formal affordances does the game inspire regarding how the player interacts with the collaborator? How might the player contribute their own ideas? How could the player take inspiration from the ideas of the collaborator? Balancing questions such as these against what the game actually allows the player to do will be a fruitful way to disambiguate pieces of shared authorship from one another, as well as revealing design areas that need to be further explored.

Of course, now that I've broached the topic of agency, and explored how in theory high agency can be found in pieces of shared authorship, I would be remiss if I neglected to discuss how the notion of a high agency experience in some ways clashes with the cause of storytelling. In brief, a well crafted story is a causal chain of events, where ideally every line of dialogue, every sentence, every word, is a carefully selected addition, chosen for the meaning it contributes not only to its local context, but to the overarching narrative as a whole. To achieve this one must be a great writer. A master of their craft. Most of us, sadly, are not great writers. Though it could be noted that games like *Monkey Island*, *Quest for Glory*, and *Mass Effect* have a relatively small number of possible paths, each one is, generally speaking, guaranteed to be a path of quality, designed by folks who know what they are doing to tell a story they wish to tell.

As a brief aside, Noah Wardrip-Fruin details in Expressive Processing [309] how games such as the above that use simple flags to check the player's progress in various stages of their quests are susceptible to lapses in coherence. If the player happens to do things in a sequence unanticipated by the game designers, this can often result in characters referring to outdated events, unaware of what the player's character has done, with the player having no means to inform the characters or game of the updated situation. So even the narrative in games such as these might still lack clarity and unity when the player is given agency.

What hope, then, does narrative quality have in a piece of shared authorship, when the story is crafted by a player that is—in all likelihood—not a professional author, in collaboration with an equally novice human or a piece of nascent technology still on the cusp of understanding what narrative even is? The narrative quality of works of shared authorship are likely going to be different than that of traditional games. If measured by traditional means, it might be fair to say that the quality may in fact be lesser, though that said, one might imagine a skilled author approaching a shared authorship system and creating something astounding. One could also imagine a novice creating a great work as well; I mean to cast no aspersions towards the artistic capabilities of anyone. Regardless of this, narrative quality may not necessarily be the goal when engaging with a piece shared authorship. Though the pleasure of consuming a precisely crafted narrative might not be readily afforded, pieces of shared authorship have a bevy of pleasures all their own. By discussing these pleasures, I hope to convince the reader that what is (potentially) lost with regards to narrative quality is exchanged with other sources of joy difficult to find in games today.

1.2 The Pleasures of Shared Authorship

Why, you might wonder, gentle reader, would anyone willingly choose to engage in a piece of shared authorship. You may very well share the outlook of my Advanced Playwrighting professor—the inestimable and brilliant Jim Bierman—that it is the responsibility of the playwright (or author, or game designer, etc.) to craft the single best experience that they are capable of producing, and to share that rendition, and only that rendition, with audiences. Oh, sure, perhaps along the way there might be rough drafts and edits that are seen by a select few in the service of revision; prototypes rapidly consumed by "tissue playtesters"[4] to answer specific questions towards the service of the final product. In this view, it is the playwright/author/game designer/creator that has the skill, experience, or vision necessary to manifest something worthy of consumption by others. To ask one's audience to contribute to the final product is at best an act of laziness, and at worst an admission of one's inability to bring a project to life on one's own, for indeed, if the audience is playing a significant part in the artifact's creation, should it not be the audience that deserves the accolades of creator?

While a work of non-shared authorship may have the capacity to spark joys that cannot be found in works of shared authorship, the argument I am making in this dissertation is that works of shared authorship have the capacity to elicit *different and unique* types of pleasure. Let us discuss some of those potential pleasures, seven of them to be precise: *the act of creating*, *the act of sharing*, *learning about one's collaborator*, *feeling understood by one's collaborator*, *developing transferable skills*, *feeling that one is making artistic choices driven by craft and design*, and *the sensation of being an important part to an important whole.* This list is by no means meant to be exhaustive, but should hopefully serve to illustrate why pieces of shared authorship might be actively

[4] A somewhat unflattering term referring to a playtester who may only playtest a game a single time, lest their familiarity with the game render them unable to provide impartial feedback or otherwise speak to the new user experience.

sought out, and are worthy of study and creation.

I will be referring to these pleasures throughout the rest of the document. Starting in chapter 2 as I look at technologies that power interactive narrative experiences—as well as those experiences themselves—I will draw upon these pleasures as a means to discuss the efficacy of these experiences and technologies as pieces of (or enablers for) shared authorship. To explain these pleasures, I draw upon several examples of human-to-human collaboration. Though it might be difficult to imagine some of these example pleasures as one a player might feel when engaging with an interactive digital storytelling system, as will be revealed through my discussion of my work and research (and the research of others), I believe that a goal for digital shared authorship experiences should be to capture these pleasures. Though they might take slightly different forms in a digital collaborative environment, the central tenets and ideals of these pleasures can and should be pursued and embedded in shared authorship experiences. And when paired with the eleven dimensions of shared authorship (alluded to at the beginning of this chapter, and covered in greater depth in chapter 3.2), I believe provide a good vocabulary with which to discuss the ways a work succeeds and fails as a piece of shared authorship.

1.2.1 The Act of Creating

There is satisfaction to be found in crafting something with one's own hands. Although it might not have the same level of quality of that same work created by a professional, the act of creating something on one's own imbues it with a significance that cannot be reproduced in any other fashion.

A simple analogy is to think of a novice woodworker, constructing a simple, four legged table. In order to construct their new furniture, our woodworker must first have decided upon the desire to craft a table. Holding this desire in their heart, they then must design what they want the table to look like, procure the wood and tools to form the table, apply their tools to render the wood into usable pieces, treat the wood through sanding and staining, and finally assemble the pieces to form the finished product. If this truly is our woodworker's first foray into table making, chances are the table will be of a lower quality than what they would have been able to acquire had they simply purchased one from their local table store; perhaps the sanding will be uneven, the legs wobbly, or countless other pitfalls a woodworking neophyte is likely to succumb to.

Remember: the woodworker's goal was not to have a perfect table. It was to have a table that they created on their own. The world is a big enough place, filled with enough people with diverse needs and desires, that occasionally folks will want to purchase a table that already exists, and others will want to make one themselves. As Ellen Dissanayake puts it, "There is an inherent pleasure in making. We might call this *joie de faire* (like *joie de vivre*) to indicate that there is something important, even urgent, to be said about the sheer enjoyment of making something exist that didn't exist before[.]" [56]. Though this pleasure certainly does not preclude the possibility of having a polished, finely crafted, or otherwise beautiful end-product, it is the act of creation itself, the *joie de faire*, that it refers to.

Likewise, sometimes players will want the finally crafted experience of a *Monkey*

Island, while at other times they might yearn for a more direct hand in crafting the experience[5].

1.2.2 The Act of Sharing

Once one has produced an artifact, it is common to want to share one's achievement with the world. In many cases, other people are the direct motivation for crafting the artifact in the first place; books are most often written for readers, movies filmed for viewers, plays penned for audiences, games designed for players. Even our woodworker may have created that table to entertain company, or to give as a gift.

The artifact created is an expression of one's self as an artist; a snapshot in time of their current ability in the craft at hand, and a testament to the artist's dedication that they were capable of combining disparate parts into a cohesive whole. This is not to say that the act of creation immediately leads one to a desire to share; on the contrary, given that an artifact is a representation of the artist's values (they *chose* to spend time making that table), sense of creativity (only four legs, hmm.) and aesthetics (*that's* the color they went with, eh?), and technical ability (the legs *are* a bit wobbly, after all), it is understandable that they might opt to never share their works with others, and simply be content with the pleasures of creation in private. This philosophy is completely valid, and I wish all the best for the artists who create simply for the joy of

[5]This direct hand can take many forms, and can be seen in various capacities throughout culture, including the business models of things like assembling a stuffed animal companion through Build a Bear Workshop or putting together a sandwich at Togo's. This can also be seen in something as simple as assembling a jigsaw puzzle; the image revealed by solving said puzzle might have been more easily obtained by simply purchasing a print of it. Though that print would lack the seams between pieces, it would also lack the sense of accomplishment that comes from piecing something together.

creating[6].

For those brave enough to have their work seen by others, they are often rewarded with the pleasure of seeing their work enrich the lives of others. And in the world of interactive storytelling, only a work of shared-authorship is capable of creating playthroughs that are worthy of being shared, as the narrative playthroughs of non-shared authorship works will be virtually identical.

1.2.3 Learning About Your Collaborator

The previous pleasures discussed, though certainly applicable to shared authorship, can also be derived in the process of creating something on one's own, as evidenced by our woodworker. An important component of shared authorship is the notion that there exists a collaborator; it is after all with this collaborator that the authorship is being shared. Let us shift our running example from the craft of woodworking—an activity which I confess to have only rudimentary knowledge of—to one with which I have much greater personal experience: the craft of improvisational performance, or improv for short[7]. I imagine that woodworking can be, and likely often is, done in collaboration

[6] And, indeed, there is something to be said for withholding one's creative work. Several studies have shown that, when sharing one's work with others, the nature of the feedback received can greatly vary the impact it has on the creator [118, 322], ranging from encouraging greater quantities (and more creative) work from the creator, to discouraging them from continuing to produce. So, though sharing creative work with others—and specifically receiving feedback on that work—is no guarantee to lead to pleasure, it at the very least has the potential to, even when the creator is starting from a place of dissatisfaction [323]. Thus, I simply wish to reemphasize that sharing one's work is not a guaranteed path to pleasure, but rather a potential one, and one which shared authorship experiences are better suited to tap into than interactive narratives that do not exhibit shared authorship qualities.

[7] To be precise, I have been performing short-form and long-form improv regularly for ten years, as of the time of this writing, and have been studying it and performing it irregularly long before that. I have been on multiple teams, including two college teams recognized to be among the best in the nation [67], I was a mainstage player at the Ultimate Improv theatre in Los Angeles (one of the quickest students to "graduate" from classes to a team in the theatre's history), and I've taught multiple workshops on the

with others; I could not say for sure. Having regularly performed in improv shows for over ten years, I can speak with some amount of certainty that collaboration in improv is not merely a possibility; it is a requirement[8].

I'll discuss improv more in 2.2.3, as it is an art form with ample history, not the least of which originates in the stock characters and lazzi of the Commedia dell'arte [182]. Improv, as wriggly and amorphous as it was at its birth, has over the years evolved into a wide variety of forms; each with their own nuances that take on meanings unique to the teams that perform them. To make the concept tractable, let us—just for now—accept that by "improv" I refer to two or more people on a stage, in front of an audience, saying words and taking physical actions that were not written in a script nor conceived by a director prior to the performance.

Given this simple understanding of improv, let us return to our exploration of the pleasures of shared authorship. The process of learning about one's collaborator can be a source of great joy. Although many improv theatres provide opportunities for ephemeral improv partnerships—often colloquially referred to as improv jams—in which improvisers take the stage as strangers to one another, most improv is done through a team or troupe. These teams often rehearse or practice regularly. "But wait", I hear you say, "rehearse for improv? Surely you must be mistaking, as the very premise

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craft at schools, festivals, and theatre conservatories. Though much of what I say on the subject comes from my personal experience, my knowledge was of course shaped by my teachers and texts, including but not limited to J.D. Walsh, Johnstone, Spolin, Napier, Griggs, Jagodowski and Pasquesi, Halpern, and Close. [109, 272, 178, 92, 106, 94].

[8]Yes, yes, occasionally there are solo improv performances, but they are exceedingly uncommon. Moreover, any piece of theatre—even scripted—adapts in subtle ways to the energy of the room. The audience's attention, laughter, applause, and even breath can have surprisingly profound effects on a performance.

of improv is that there is no preexisting material prior to performance! How can one rehearse when there is no material to rehearse with?" The answer is that the rehearsal process for improv is less about memorizing lines and blocking, and more about the development of learning the idiosyncrasies of one's team, and one's place within it. This is in part recognizing patterns in the performances of one's teammates; noticing that certain teammates might be more inclined to take scenes in certain directions will make you better equipped to take those directions in stride whenever you find yourself performing with them.

More than this, the rehearsal process can open one's mind to different perspectives. These perspectives might be as simple as different approaches to improv or performance in general, or as grand as different life philosophies or ideologies. To become familiar with another artist's background enables one to understand some of the decision making that goes into their performance. To be able to map specific choices (e.g., they took this scene in this direction) to specific beliefs, biases, or baggage reveals a deep connection to a scene-partner, and the realization of that deep connection can be a source of pleasure. Similarly, having a deep understanding of the tendencies and background of an artist enable one to more deeply appreciate when they deviate from their habits and break out of comfort zones.

Moreover, it is, I believe, a prerequisite to achieving a "group flow" [252]—a play off of Csikszentmihalyi's flow theory [51] (which typically applies to individuals), a notion oft applied to games [36]—a state of being where collaborators are (seemingly) effortlessly playing and building off of each other to create a unified whole. This applies to other contexts beyond improvisation too; cast bonding is an important component of the rehearsal process for scripted theatre, and as I'll discuss in covering the next pleasure, communal trust and understanding is important for any group activity. This brings us to the other side of the coin, and our next pleasure: while you are getting to know your fellow contributors as artists and as people, they are returning the favor to you.

1.2.4 Feeling that the Collaborator is Getting to Know You, and Trust

Your fellow artists are learning about you all the time; your artistic choices and predilections reveal world views and beliefs which can then be leveraged and played against. When your co-creators understand you at this level, you not only benefit from the pleasure of feeling understood, but you have people in your life that are now positioned to push you to become a better artist.

Additionally, when you feel understood by your fellow creators, and you believe you understand them in turn, the all-important quality of trust is born. Trust is the font from which collaborative work springs. In an improv setting, trust is what enables us to enter a scene secure in the knowledge that our partner *has our back.* That they will endeavor to make choices which make us look like we are smart, funny, and *effervescent* on stage. That they will do everything in their power to ground the scene in reality, that they will commit to their character choices, honor our own, and will work to create an honest, genuine relationship between the two. Trust in our scene partner enables us to make bold choices, for we know that even if we fall, we will be caught.

Trust is what gives an artist the ability to provide feedback and insight into a peer's performance, and to gracefully accept constructive criticism towards one's own. Trust is the great slayer of physical tension—one of the performer's few enemies that cannot be twisted into augmenting a performance—and is the secret to achieving the contradictory goals of pushing one's self out of a comfort zone and feeling safe and supported while doing it.

Conversely, a lack of trust is a great stymieing force; creativity is replaced with doubt, and courage with concern. True, there might be some titillation to be had in working with the unknown. The aforementioned improv jams afford the opportunity for strangers, with no established history of trust, to potentially make magic together. In their defense, one of my favorite improv scenes that I've ever had the honor to be in was born from a jam, with a scene partner I had never met—let alone worked with—prior to the performance. However, I have found this to be the exception rather than the rule, and since discovered that though we shared no performance history together, we both entered the scene sharing many beliefs about the craft of improv (as well as a distaste for jams).

This sense of trust is important in any collaborative environment, artistic or otherwise. In a game of *Dungeons and Dragons* [93], though the party members might diegetically be mistrustful of each other (e.g., a lawful good paladin might be dubious of the intentions of an unlawful rogue), the players assuming those roles should—in theory—be trusting that every player is doing their best to make the night a success[9].

[9]Of course, anyone who has played *Dungeons and Dragons*, may be familiar with the notion that there are many ways to approach playing the game—focusing on the role-playing, the story, the combat, the massive rule books, etc.—and any given player in the group might be focusing on a separate aspect of the experience. Trust, here, then might refer to all players approaching the game from a similar

Or in the realm of professional athletics, there exists evidence that a player's perception of the efficacy of the team as a whole is a more accurate measure of efficacy than a player's perception of the skill of individual players [73].

By and large, to be at one's creative best in a collaborative environment, one must make a conscious effort to understand one's collaborator, and to feel understood in turn. This is not always easy, particularly when working with someone so different from one's self or one's previous collaborators, but when successfully done can be a source of immense pleasure.

1.2.5 Developing Transferable Skills as a Creator

As one creates, it is natural that one's facility with the act of creation will grow; as one's pool of collected experience expands from a puddle to a lake, one has more material to draw from to inform future works. That very same pool, though, can serve as a well of experience for other endeavors. In other words, creating something not only results in a created artifact, it results in the development of skills which can be applied to both the creation of future artifacts, and that can likely be transferred to other contexts entirely.

Continuing our improvisation running example, let us take as a given that doing improv makes one better at doing improv [86]. This could be argued; though there

viewpoint; for example no one player being any more of a stickler for following the precise rules as anyone else, as adhering to rules to the letter or not is not in and of itself better or worse than not doing so; it is where different players have different attitudes towards this practice that extra-diegetic scuffles might arise. Of course, this extra-diegetic scuffles are not even necessarily negative either. Indeed, as Peterson's Playing at the World [203] details in its extensive history of tabletop role playing games, conflicting foci amongst players helped lead to *Dungeons and Dragons* very creation.

might be some truth to the old adage "practice makes perfect," unless the practice itself is perfect, one runs the risk of reinforcing bad habits, ingraining them into one's craft. But let us hypothesize a scenario in which one's practice—if not perfect—is close enough to perfection that one continues to grow more comfortable performing improv.

Improv, it just so happens, can be considered the culmination of a large variety of component skills, each of which are also important in other contexts. To quickly go through a few items on the list, improv can help those who perform it develop public speaking skills (useful for giving a presentation at your next business meeting!), panoramic awareness (great for waiters that need to manage a restaurant full of tables!), character development and motivation (terrific for writers of screen, stage, and page!), and performance ability in general (as the great David Razowsky once told me, "not every actor is a great improviser, but every improviser needs to be a great actor"). Vera and Crossan discuss in [307] a variety of ways in which the process of learning improvisational performance can be applied towards firms.

Of course, improvisational performance is by no means the only context to which this pleasure applies. Indeed, nearly any act of creation can evoke this particular pleasure; taking cooking for example. Just last week, I took my first attempt at preparing dishes of chicken tikka masala and saag paneer. Doing this, in some small slight measure, certainly made me better at cooking these specific dishes, as the next time I do so I'll be more familiar with the steps involved. Doing so reinforced knowledge transferable to other dishes, such as sauteing[10], but more than that, preparing these two dishes in tandem

[10] I realize that sauteing is a pretty basic culinary action, but I sheepishly confess that I'm a novice enough chef that I needed to confirm with a housemate what sauteing meant

required making plans, such as figuring out how to efficiently optimize stop-top use and prepping ingredients while sauces simmered and meat marinated. The ability to plan is applicable both inside and outside of the kitchen. Moreover, as was shown in [185], spending time in a kitchen studying under a master chef allowed a software designer to better understand a space of culinary solutions—turning the "tacit" knowledge of the chef to an "explicit" knowledge that the software designer was able to articulate to their team—and led to the design of a record-breaking product for their company. Though not all such skills might be as lucrative, similar arguments could be be made for many acts of creation.

Creation in a shared authorship context adds a slew of additional transferable interpersonal skills[11]. Learning to voice and defend ideas articulately in a supportive environment will improve skills in self expression when faced with opposition that requires persuading. Allowing another's creativity to influence one's own engenders compromise. Working together to create something helps nurture—and is the very definition of—teamwork.

It feels good to improve one's self, and even better when that self improvement can be applied in a variety of contexts. Though the specific points of growth are dependent on the nature of the activity, contributing to a work of shared authorship should, ideally, make one feel the pleasure that one would feel honing a craft. Speaking of which...

[11] Interpersonal skills are generally regarded as both highly valued and generally transferable [264, 200].

1.2.6 Feeling that your Artistic Choices Took Craft and Design

It feels good when you make something that you believe took craft. This is related to the pleasures of creating outlined in 1.2.1, but slightly different. By this, I refer to the sensation of creating something which you believe to be an expression of yourself as a creator. The belief that what you produced is—in some sense—uniquely you[12].

Let us introduce yet another example to illustrate this particular phenomenon: LEGO sets. For the uninitiated, a LEGO set includes a multitude of individual LEGO bricks, and a step-by-step guide informing readers how to assemble the bricks to form a specific piece of construction such as the Taj Mahal or the Millennium Falcon. Following the included guide would activate the pleasures of 1.2.1; the stalwart brick layer has fabricated order from whence before there was chaos, a brilliant work of architecture composed of humble bits of plastic. That is impressive, to be sure, and required the brick layer to be able to read and understand the manual, and have the manual dexterity requisite to snap the appropriate pieces together. However, the only decision the brick layer made, the only reflection of their personality in the process, was the initial choosing of which set they wished to construct. In this scenario, most of the craft, most of the design, was done by the brilliant engineers at LEGO HQ. Our brick layer can still be—and in my opinion should be—justly proud of their handiwork, but their sculpture will be identical

[12] I recognize that the term craft is one with many connotations, ranging from generic associations with "making," to the self-sustainability and can-do-it attitude of DIY culture, to the often—and unfairly—perceived low quality nature of "arts and crafts" often evoking images of macaroni picture frames and hodge-podge pieces of felt adhered together via gluestick; none of these perceptions alone capture the notion of craft as a whole. Though I'll be moving forward using the understanding of craft mentioned above, interested readers should seek out David Gauntlett's excellent *Making is Connecting* [83] for a comprehensive understanding of the term and form.

to every other person's who followed the same instructions.

Imagine if, instead, our brick layer had followed the outlined instructions, but whenever the booklet called for a red piece, they defiantly used a yellow one instead. The architecture of the resulting artifact would still be identical to everyone else that made the same set, but theirs would be ever so slightly unique; they made a conscious creative choice reflected in their final product. To me, this reflects the distinction between building and crafting.

The simple color substitution described could be extended much further; entire towers and parapets could be added or removed by the brick layer. Sets could be combined and intermingled to create a mausoleum capable of space travel. Builders could take the raw materials and disregard the instructions entirely, crafting entirely new constructs born purely from imagination. LEGO's designs lend themselves very well to this form of craft; most interactive stories tend to either ask the player to follow the instructions to reach a specified ending (e.g., *The Secret of Monkey Island*), or allow for an amount of customization roughly analogous to swapping red bricks for yellow (amusingly apropos to an outcry of disappointment to the ending of the *Mass Effect* trilogy, in which the culmination of three game's worth of choices largely boiled down to one of three different colors displaying in the game's final cinematic).

It is also worth noting that, though useful for illustrating this understanding of craft, the uses of LEGO bricks provided above are not ideal examples of shared authorship. Following the manual is more akin to obeying directions than collaborating, and deviating from the instructions to craft artifacts of one's own has parallels to abandoning a potential collaborator to work independently. That said, one could easily imagine a scenario in which two brick-layers work together to assemble a single artifact. This has the spirit of shared authorship behind it, but also introduces the danger that your authorial voice might be drowned out by your collaborator; even when working with in a context in which you trust your collaborators—as outlined above—the chance always remains that everyone's contributions might not be even[13]. The antidote to this concern is the next pleasure I wish to discuss.

1.2.7 Feeling that you were an important part to the whole

It is important when working in a shared authorship context that all contributors can recognize their authorial influence. Their direct authorial voice might be indistinguishable, just as the singing voices from a choir blend together to form a gestalt from which it is difficult to discern individual voices. The consumer being able to recognize the individual voice is of less concern for the pleasure at hand; what I am concerned with here is the creator believing that their contributions were an important part to an important whole.

If this is not the case, if a contributor feels that that their contributions were disregarded or otherwise failed to be made manifest in the resulting artifact, then it becomes difficult to consider the artifact a work of shared authorship. This can sometimes get a little muddied, because different members working on the project together might have

[13]I say this not in a way to recognize and/or shame those who do not carry their weight in "group work" [11], nor as a call to arms to find novel ways to measure the quality of an individual's contribution, such as in [3]. I refer instead to the notion of personal dissatisfaction with one's own degree of influence in a collaborative environment

separate notions for what direction to take the work in, and it is not uncommon for collaborators to feel hurt over differences in creative vision. The need and importance for compromise is ever present (it's just another facet of trust, see 1.2.4).

Conversely, being able to recognize how one's contributions interweave with the contributions of others, even when an outsider might only be able to detect a single authorial voice, implies a trained eye over the craft itself. It enables one to appreciate the importance of any individual contribution, and how it is only through the amalgam of these contributions—made by multiple contributors each with their own backgrounds and ideas that the work itself exists as it does. To be able to produce and create something to externalize one's creativity is a delight; to see that creativity informing and informed by the creativity of others in a single piece of work is a marvel. Examples of this are plentiful; I already described the choir full of voices, but it is also present in an ensemble cast putting together a play, writing partners engaging in creative writing, game designers developing a game, and lots more besides.

1.3 The Hope for Shared Authorship

"But wait", I hear you say once more, "only a relatively small number of people identify as game designers or writers or actors or wood workers or anything like that. Would that many people really benefit from researching shared authorship?" As always, gentle reader, this is an astute question. It reminds me of a piece written by Andrew Glassner [87], who outlines a few observations on the common person's relationship to acting.

Glassner rightly recognizes improv as a skill which many folks do not have training in, and therefore dismisses it, as "[m]ost people do not know how to ride a racehorse, play the saxophone, or improvise comedy or drama." Glassner goes on to say that even if people were not asked to improvise the material but rather to put on a small existing play—Glassner chooses Shakespeare's King Lear as an example [256]—people would still struggle with it because again, acting is a skill that many do not have training in, and moreover that many roles, including that of Lear, requires accessing painful, difficult emotions to perform well (at least according to certain schools of thought). This leads to the observation that "[e]ver since plays were first printed and available on paper, people anywhere could have performed them for each other as a recreational activity. The fact that almost nobody does it is an important lesson for designers of interactive fiction." "In summary," Glassner concludes, "most people are not skilled actors, and do not enjoy it, regardless of whether they are making it up or working from a masterpiece."

This is a grim outlook and, if true, does not bode well for the future of interactive narrative, let alone shared authorship. However, I feel that Glassner's argument is something of a self fulfilling prophecy. Acting and improv are difficult skills, true, and it may be the case that most people do not choose to spend their evenings doing table reads of *King Lear*. But Glassner implies that the reason why this is the case is because people do not enjoy it, which I am skeptical of. People *do* spend their evenings engaged in lighter-weight, shorter, more structured activities that involve performance and share many similarities to the above, such as playing *Charades* or *Dungeons and*

Dragons. I believe a more likely reason as to the cause of people not engaging in this type of behavior is similar to the reason why I have not learned how to ride a race horse: because I have not had the the opportunity to learn, and because it seems dangerous and frightening. This does not mean that there is anything inherently wrong or vexing about horse racing; it just means that there is a lack of opportunities to learn in a safe environment. The pleasures of shared authorship listed above are not easy pleasures; they come as a result of hard work and creation, and often involve pushing the creator outside of their comfort zone. By developing technologies that afford contexts of shared authorship, we hope to provide a safe, easily accessible space for people to develop skills that they otherwise might not have the opportunity to. People have had access to scripts since the printed page, true, but people typically lack access to a supportive collaborator willing to play make-believe to a degree of intensity that all parties involved are comfortable with.

The essence of this research is to make this possibility—and others like it—more accessible. The existing games that comprise the vast majority of the market today, the *Monkey Islands* and *Mass Effects*, are wonderful in many ways, and elicit no dearth of pleasures of their own. These pleasures include, but are certainly not limited to, telling well crafted stories that can have a lasting, perception-shifting impact on the player, the sense of achievement from overcoming difficult challenges, or the social capital that can come from being knowledgeable about a shared piece of popular culture. I do feel, though, that they do not provide the pleasures of shared authorship outlined above. Is one set of pleasures more beneficial to society at large? Are some pleasures morally superior to others? These are large philosophical questions which I am certainly not capable of answering. In my defense, I choose to believe that no one will be capable of answering them until more work has been done in this research area. So let this dissertation be the starting point of the conversation. I look forward to learning more of the benefits and shortcomings of shared authorship in the years to come.

I do believe that we are already off to a good start, however. My first research question asked how one might define a space of shared authorship that can both describe existing existing works, as well as point the way towards unexplored design directions. Although we are still a long way towards answering that, I believe the topics addressed in this chapter provide us with a solid foundation upon which we can continue to build our understanding of the form. By discussing the notion of shared authorship through a handful of story-game examples, I have begun to carve out a space under the umbrella of interactive storytelling to which shared authorship lays claim. By discussing the pleasures that can be had in engaging with works of shared authorship, I have outlined several qualities with which we can examine narrative works to develop a sense of the shared authorship properties they possess or lack.

Next, I will begin a discussion of the theory behind shared authorship by exploring existing work in both computer science and theatre arts that has been applied to the cause—or easily could be—and identifying the affordances they provide players in their resulting experiences, and authors in the shaping of those experiences. This analysis will also propose a series of metrics with which one can describe a work of shared authorship, presented through the lens of a diversity of games and interactive experiences that exhibit those pleasures or make use of the covered technologies and philosophies. Doing this will finally provide us with an answer for our first research question, by establishing a vocabulary—and visualizing a 2D space—to describe and show the aforementioned unexplored and under-explored regions of design space.

I will then begin to answer my second question through an exploration of several pieces and technologies built by myself and my colleagues that the first part of my dissertation shows to be at the edge of shared authorship design space. This exploration begins with an in-depth analysis of the social simulation game *Prom Week* [152], a game which can be considered a work of shared authorship. This analysis will consist of three parts: discussing the underlying technology that enables it (Chapter 4), discussing the game itself (Chapter 5), and finally taking a look at some methods of evaluating the stories produced by this system which enables the player to have this degree of authorial control (Chapter 6). This is directly inspired by the notion of expressive AI [140] and the attempt to "build it to understand it" [141]; technology developed to explore new design spaces can only be evaluated through playable works in that design space.

This loop of technology-experience-evaluation will be repeated for *Bad News*, an experiment of shared authorship that combines live improvised performance and procedural content generation (Chapter 7). I will then briefly go through this loop one last time for a prototype piece that is currently in development as a means of showcasing exciting future work that this mode of thinking might enable (Chapter 8). Finally, we will bid adieu to each other by summarizing all of the above, while hopefully inspiring and galvanizing you, gentle reader, to produce and engage with pieces of shared authorship yourself (Chapter 8.5), perhaps achieving pleasures that the works described do not yet not touch on.

Okay, that sounds like a lot! We better get started.

Chapter 2

Towards a Theory of Shared Authorship

Up to now, I've spoken a little bit about what shared authorship is and is not by discussing it through the lens of a few classic works of interactive narrative. I have introduced a few useful concepts for discussing these works, such as the notion of agency and having an ontological mode of interaction with a piece. Perhaps most importantly, I have covered a few of the pleasures inherent in this type of work, that should motivate not only playing with these experiences, but creating them in the first place. My hope is that by this point, gentle reader, you are beginning to develop a sense as to how shared authorship fits into the greater pantheon of works of interactive storytelling.

However, there are many other facets of research into interactive storytelling that I have not even began to cover. This chapter will attempt to further flesh out the theory behind shared authorship by comparing and contrasting it against research and philosophies from game design, interactive storytelling, and theatre. Doing this will enable us to identify several different qualities that works of shared authorship might possess in varying amounts. It will also provide context, vocabulary, and concepts that can be applied towards the creation of future works of shared authorship. Once these are recognized, in chapter 3 a variety of games are measured along these axes to develop a sense for what it means for something to have weak or strong membership to the notion of shared authorship. Doing this will not only provide us with a map identifying the well-explored and under-explored regions of this design space, but should give us a vocabulary with which to describe what would need to be developed in order to break this new ground. Though this chapter primarily consists of a literature review, there is original thought regarding shared authorship throughout the chapter as well. Therefore, those with familiarity with the topics addressed herein are invited to largely skip this chapter, but do so with the potential risk of missing nuances of shared authorship theory.

We'll begin by discussing other work that is connected to interactive storytelling, creation, and collaboration.

2.1 Related Work: Technological

Let's go find some giant's shoulders to stand on, shall we?

2.1.1 Constructive and Sculptural Fiction, and the Story System

Perhaps the closest lines of thought to shared authorship are those of constructive fictions, later evolved into sculptural fiction, by Aaron Reed [215, 217]. Reed discusses how constructive fiction is a specific type of "story system," a computer program that tells complete multi-form stories. Reed elaborates that a single game or media artifact might have multiple story systems within it. For example, one could imagine a role playing game made up of multiple quests. If one quest made use of branching decision points to allow different players to make different choices, while another quest is simply a static list of objectives to be carried out in a set sequence, then the former could be considered a story system, and the later would not.

Reed first sets up his description of sculptural fiction by noting that many classic story systems offer false choices – choices that might be painted to seem important but ultimately prove inconsequential (much like what was discussed in my examination of the string of beads, see figure 1.1) – and further typically offer mutually exclusive branches, in which the selection of one choice precludes all other branches. This can fill the player with a sense of anxiety, fretting that they might have made the "wrong choice." Wrong choice, here, can either refer to the player's subjective experience of not getting a particular result they desired (e.g., the death of a favorite character, two star-crossed lovers not ending up together, not gaining access to a powerful weapon, etc.), but can also refer to the more objective notion of a "bad ending." Choose Your Own Adventure books, for example, are rife with choices that lead to the main character experiencing an abrupt death or some other equally unsatisfying end to their adventure. Many video games do not tend to have such tragic calamity sprinkled throughout their stories, but instead wait until the very end to unveil that the player's choices were leading them down a path of ruin.

One nice example that encapsulates all of this is *The Neverhood*, a point and click graphic adventure game with puzzle solving elements and a linear progression to it akin to *The Secret of Monkey Island*. The game has three potential endings. The first is a "bad ending" as might be found in a Choose Your Own Adventure story, where players encounter a mysterious hole with clearly marked 4th-wall breaking signs informing the player that if they jump into the hole, they will die. The signs, as it turns out, are completely truthful; jumping into the hole results in the end credits rolling as the player's character falls into an endless expanse of space. The other endings are not as clearly telegraphed. At the game's climax, the player is given a choice to place a crown of ultimate power onto the head of the rightful ruler, or to don it themselves. Either choice leads to a different ending and, though the beauty of an ending is certainly in the eye of the beholder, handing the crown to the rightful ruler results in the world returning to its former splendor (and marks the successful completion of the quest that has been driving you from the beginning). Keeping it results in your character becoming a corrupted version of their former selves, ruling over a desolate emptiness. It is upsetting, to say the least.

The Neverhood, thankfully, provides the player with the results of these game-ending choices immediately. Other, less forgiving games, can lead the player into what is known as an "unwinnable state." One such example is in *King's Quest V* [317]. The King's Quest series is perhaps the most notable of Sierra's "Quest" family of games (of which I've already spoken of the *Quest for Glory* line in 1.1.2). In *KQV*, there is a moment where—at a seemingly arbitrary point—a mouse scurries across the screen and, unless the player intervenes, is immediately caught by a cat. The game makes no fanfare about this moment, but if the player leaves the mouse to its fate, they will have unknowingly doomed themselves, as the mouse is the only creature capable of gnawing through the player's ropes when—much later in the game—the player finds themselves bound in the cellar of an inn full of thugs.

Here, not only is there a great delay between the time when the player was asked to "make the choice" (either the player saves the mouse or does not) and its consequences (either being rescued from the cellar or being snuffed out), but the "choice" itself is unclear. The cat catches the mouse so quickly that the event can easily end before the player has time to register what is happening, let alone react), nor upon the player's death in the cellar is there anything indicating that things might have gone differently had only the player rescued the mouse. The player, by all rights, will be oblivious to the fact that they worked themselves into an unwinnable state unless they start the game from the beginning (or load a previously saved state prior to the mouse getting caught) and successfully manage to stop the cat.

Sometimes, these two tenets that Reed observes (false choices, and irreversible decisions) are intimately connected with each other. David Cage of Quantic Dream [209] specifically called for players to only play his heavily narrative game *Heavy Rain* a single time [82]. Ostensibly the reason was because he wanted players to feel an ownership over the story they had created for themselves; in practice it might have had more to do with the fact that almost none of the seemingly very important decisions made in the game have a lasting impact beyond the scene in which they transpire [315].

Reed's call for sculptural fiction is a response to this type of interactive storytelling. Reed defines sculptural fiction as "works that involve frequent small but reversible decisions, to create a play aesthetic closer to a sculptor constantly refining a work than a rat navigating a maze." In none of the experiences that I have discussed thus far are decisions reversible (short of the aforementioned meta-game level ability to load a previously saved game state). This adherence to reversible decisions is not a pre-requisite for works of shared authorship, as we will see in quite a few examples. However, the aesthetic goal of aiming to build and refine a single piece that is pleasurable to all contributors is one that is shared by works of shared authorship.

Reed discusses a few examples of his own work that adhere to this tenet. His piece *Perfect* [211] is perhaps the purest representation of the above definition. In it, players alter story content by manipulating a handful of sliders; each slider corresponding to a different aspect of the narrative. By fine tuning the positions of the sliders, the player is able to slowly construct the story as they wish. At no point are they locked into their decisions, and can easily experiment with different slider values to see how the story is affected. Another example of Reed's work that adheres to this is *18 Cadence* [212], a piece which tells the accumulated stories of one hundred years of history of a fictional house and the people that lived in it. The player does not have the ability to alter this history in any way. However, they are able to take snippets of this history via short textual fragments, and assemble them on a digital workbench of sorts to tell their own stories. Reed has expressed delight that players have shown ample creativity with this affordance; some players have composed metaphor-laden poetry about the game's characters, others have told entirely different stories, while others still have arranged thematic collages, such as putting together every in-game reference to literature.

In both *Perfect* and *18 Cadence*, the player takes on the role of an editor. The game provides raw material to work with, which the player has the power to shape into their own stories; stories that they personally find satisfying. This is one of the central ideas behind shared authorship; for a system to be complex enough to allow for a vast degree of player expressiveness, and specifically for a player to feel like they have the means of creating a story that they themselves are proud of. Though the relatively small number of total possible combinations of stories present in *Perfect* make it vulnerable to the same trap that *Mass Effect* fell into, the sheer number of ways in which the text can be recombined in *18 Cadence* ensures that the likelihood of two players making the same story is exceedingly low.

However, though both of these experiences have the qualities of allowing the player to create their own stories, they are missing a very important cornerstone of the notion of shared-authorship: neither system has a mechanism for understanding the story that the player has made up to that point. *Perfect* has procedures to understand what the current values of the sliders are, and return the corresponding text, but that text is pre-written and pre-assigned to the slider values, independent of the interactions of the player. Meanwhile, *18 Cadence* has no processes capable of reasoning about the text snippets the player has assembled. They are collaborators to the resulting story in the same way that a toy is a collaborator to the joy of the child playing with it; it was the human that produced the result. This raises an interesting distinction between *collaboration* and *facilitation.* The easiest comparison is regrettably fraught with violence and politics, please forgive me. You may be familiar with the popular anti-violence (but pro-firearm) saying "guns don't kill people, people kill people." The comical but apt rebuttal goes to the tune of, "well, yeah, but the gun sure made it a whole lot easier." In this unfortunate analogy, the gun would not be considered a collaborator to a murder, as the gun itself had no agency in the process, but it certainly facilitated it. So too do these works facilitate the creation of stories, without directly collaborating with the player in their creation.

Reed's follow up work, the *Ice-Bound Concordance*[1], continues to refine the ideals of sculptural fiction while also providing a true collaborator. An in-depth breakdown of the piece can be found in [213]. Briefly, players assist an artificial intelligence—a digitization of a fictional deceased famous author—in completing his great, unfinished masterpiece. Players do this by "shining lights" on important story components; on any given level, the number of lights players have to shine is far less than the number of components available. True to the spirit of sculptural fiction, players have the freedom to rearrange their lights at any time as frequently as they wish, to experiment with the results different combinations yield.

The different combinations not only indicate which characters and set pieces should take on the most narrative weight, but also determine the overarching themes of the story as a whole. As the game continues, the underlying system begins to get a clearer and clearer sense of the story the player is trying to tell, and will present story components and thematic elements that ascribe to its interpreted vision of the player's goals.

[1]A collaboration with Jacob Garbe.

This is, in many senses, the dream of shared authorship achieved, and without question at the time of this writing *Ice-Bound* is one of the best examples of the aesthetic designers can aspire to today. It hits on many of the pleasures discussed in chapter 1.2; it gives players the ability to construct a story that is all their own. It involves a collaborator that is learning about the aesthetic predilections of the player, and shapes its own contributions to match. The algorithm which determines which story components are available has a pool to draw from, which the player then must work with, and thus the collaborator has a means to exert their own influence or will onto the story. The combinatorial space of potential stories that can be created ensures that nearly every player will create a version of *Ice-Bound* that is unique to them. Even the conceit of *Ice-Bound* entails the player working alongside a digital collaborator, KRIS, to create the novel.

With *Ice-Bound* successfully tapping into so many of the pleasures of shared authorship, does that mean that shared authorship is a solved design space? As enamored as I am with it, I would say that there is still more work to be done. This is in part because a single point hardly constitutes a fully explored design space; it takes two points to make a line, after all, three for a plane, and most design spaces are bumpy places, replete with mountains and valleys that a single plane couldn't hope to fully capture. But more specifically to *Ice-Bound*, based on my personal experiences with it, I would say that the game is so seamless at presenting the player with choices, that—despite the narrative framing of collaborating with KRIS—it is often unclear just how much work the system is putting in behind the scenes to be a collaborator. As discussed in [213], but explored in even greater depth in [81], the creators of *Ice-Bound*, Reed and Garbe, put a vast (yet efficiently allocated!) amount of thought and authoring effort into the raw content that players will pick from to pen their perfect *Ice-Bound*.

But the story components that are presented to the player as they delve deeper into the game's many layers so naturally tailor themselves to the player's previous choices that I believe that it lessens the perception of collaboration, even though it is clearly present. However, if the player can not sense it, then it is difficult to attain several of my outlined pleasures: it is hard for the player to feel like the system is learning about them as an artist, or that the player has the ability to learn about the artistic choices being made by the system.

This is, in my opinion, a fascinating "problem" to have. In conversations with Reed about another of his great works, *Blue Lacuna* [214], the largest Interactive Fiction written to date, he claimed many players made choices that led them down paths so distinct from others—yet still being rich with important plot altering events—that players assumed that certain plot points were a part of everyone's experience, and expressed shock when they discussed their playthroughs with others and discovered that what they had experienced was entirely absent in others' playthroughs. *Blue Lacuna* was primarily written with the Choose Your Own Adventure branching narrative paradigm, which credits the system—and Reed, particularly—with the quality and diversity of unique stories that can be created using that structure with good writing and dedicated authoring effort. But this is a similar situation discussed with *Ice-Bound*; players' choices were so seamlessly being taken into account that they did not even realize the full impact that they were having on the story.

This, perhaps, speaks more to the players than it does to the systems they are playing with. So accustomed are they to "on rails" narrative experiences where choices they make have minimum impact or deviation from the core story the game designers have crafted, that they have developed something approaching a cynicism towards their own agency to impact narratives. As more interactive narrative experiences are developed in which players have the capacity for true ontological impact on the plot, this cynicism may fade and be replaced with expectations that the story they create will be truly determined by their own hand. At present, players simply lack an ample choice of experiences to develop this understanding.

In spite of that, I believe this also speaks to an interesting design consideration perhaps unique among works that aim to elicit the pleasures of shared authorship: it is important for the collaborator—and specifically, the collaborator's contributions and artistic process—to be made apparent. If the experience is too immersive [177], players may be unaware of the procedures and algorithms with which they are creating their art. I will discuss some ways to experiment with immersion in 2.2.1, but for now, bear in mind that immersion, so often taken for granted as a staple of the interactive narrative, might very well be an enemy of shared authorship.

I've been talking about the inspiring works of Reed and Garbe for quite some time by this point, but Reed is not the only game designer to apply a sculptural metaphor to the game design process. Adam Smith likens the process of developing his game *Variations Forever* [268] to one of a sculptor. In this game, game design logic and rules (e.g., how do game objects move, what happens to game objects on collision, what is the goal state for victory, how does one fail, etc.) are tied to a form of constraint logic programming called answer set programming [183]. In *Variations Forever*, players can generate an entirely new game with the press of a button; this new game will adhere to the current constraints specified; as new constraints are specified, the total amount of possible games are reduced; thus yielding a more limited generative space, but one more likely to create a game within a specific authorial intent. This provides the useful metaphor of actually picturing the entirety of possible games that could be created under such a system as a large block of marble. Each constraint provided shears a swath of marble away, the discarded stone representing the games now impossible to create given the newly provided constraints. Just as Reed's use of the metaphor resulted in authors slowly working their way towards their perfect story, so too do users of Smith's system work themselves towards the perfect generative space.

Even though Smith's application is not directly being done in the service of authoring a story, the give and take of the player learning about and affecting the artistic and expressive capabilities of their collaborator are clearly connected to the ideas of shared authorship. This, I believe, is a nice segue away from sculptural fiction, towards a body of work focusing on creating a system that makes no pains to mask its immersion and make apparent its nature as a collaborator: that of mixed initiative tools and procedural content generation.

2.1.2 Mixed Initiative Tools, PCG, Casual Creators, and Other Authoring Environments

Mixed initiative tools is an umbrella term which describes certain computer programs—designed with artificial intelligence to be able to meaningfully understand and respond to user input—meant to assist the user or player in the completion of a specific—often creative—task. It is perhaps relatively straightforward, then, to imagine how pieces of shared authorship could fall under this heading. In chapters 5 and 7 I will discuss works of shared authorship where the mixed initiative title might feel like bit of misnomer. Before that, though, I would like to take a moment to explore how previous work has attempted to apply mixed initiative techniques towards collaboration in story writing and other domains. From there, the reader will have a clearer sense as to how these techniques can be directly applied towards the cause of shared authorship.

2.1.2.1 Tanagra

I would like to begin this discussion of mixed initiative work by talking about the *Tanagra* system [271], by Gillian Smith; a piece that—though not narrative in nature—exhibits some of the clear strengths that mixed initiative tools provide, and adheres to several of the design philosophies outlined in chapter 2.1.1.

Tanagra is a mixed initiative tool that assists its user in the creation of two dimensional platformer levels, as might be found in any game in the storied Super Mario franchise [169]. The way that it does this is by allowing the user to specify certain aspects of level geometry, such as the height of platforms, the width of gaps, and the placement of enemies. Once this has been specified, the user of the tool can then ask Tanagra to “fill in” the rest of the level with geometry that it thinks will make a “good level.”

Its notion of a good level largely comes from the specifications of its user, using the specific metaphor of musical time signatures. Smith recognized that well crafted platformer levels have a certain rhythm to them, and that a player blazing through a level with perfectly timed jumps is reminiscent of a musician playing a well crafted piece of music. Working with *Tanagra*, then, is a back and forth between user and system; the *Tanagra* user will specify geometry that they like, the system will construct the rest of a level around that geometry to adhere to rhythmic goals, which the user can then in turn adjust, which the system can then further edit. This tight interchange of artistic expression upon the final level is a great example of Crawford’s Listen-Think-Speak loop in action, and is a great example of shared authorship in a non-narrative domain. Here, both level designer and procedure are taking turns making contributions to a single whole; these contributions are easily identified and attributed to their creator; they are not made in isolation, but rather inform each other. The level designer is given a lens into how the algorithm makes it decisions, and has the means to make adjustments to this decision making process directly by suggesting different rhythm time signatures. The algorithm may not necessarily learn more about the player over time, but as the player “locks in” more and more parts of the level geometry that they want to keep in the final product, the algorithm has fewer parts of the level to work with, and thus will begin to hone in on the small remaining parts that have not been determined yet, trying to make it work well within the greater whole. *Tanagra* has a deep, simulative understanding of the design choices the user has made, and does its best to work off of these choices to create a level that adheres to both the player's and its own sense of aesthetics.

For all of these reasons, *Tanagra* should be commended for tapping into many of the pleasures of shared authorship. One could make the argument that the amount of authorial control between user and system is lopsided, as it is only the player that has the affordances to lock in certain aspects of the geometry, and specify which rhythms they want the generator to use, but asymmetrical authorial control is not necessarily detrimental to the cause of shared authorship, and indeed can sometimes be immensely helpful; section 2.2.3 discusses an experiment by Keith Johnstone in which one collaborator (believes they are) guessing the story of their co-creator. I think that Tanagra is a great example of the co-creation possible through shared authorship, and many of its qualities can be adapted and applied to a narrative domain.

2.1.2.2 Say Anything and Creative Help

That said, there already exist several other examples of mixed initiative tools in a narrative context, which can be used as reference towards the design of shared authorship works. One such example is the *Say Anything* system, by Reid Swanson and Andrew Gordon [289], and the evolution of that system, *Creative Help* [226]. Both of these systems are designed to fill a role similar to a co-author; users/authors write sentences, and the systems offer suggestions as to what a good followup sentence could be. Prior to the development of these systems, the system creators developed tools to successfully identify and parse a vast amount of narrative content from weblogs [89] to develop a corpus of stories, and breaks each story down into the level of individual sentences.

Engaging with the systems begins with the users/writers free writing a sentence. Once this sentence has been written, it is now the systems' turn to suggest the next sentence of the story. To do this, the system analyzes the sentence written by the user, and compares it against the sentences from the corpus until it finds the the most similar sentence in the corpus. Once it has discovered the most similar corpus sentence, the system then retrieves the sentence from the corpus that immediately followed it, and offers it as a suggestion as the next sentence in the user's story. *Creative Help* follows a very similar pattern, although the system only makes suggestions when the user explicitly asks for it by typing a particular command, and experiments with pulling sentences from a variety of different sized corpora to see if the size of the corpus or it's content (e.g. diagetic vs. extradiegetic) make a noticeable impact.

Upon completing a *Say Anything* story, users were asked to rate their story by how entertaining and how coherent they found it; by and large the stories were more entertaining than they were coherent. This result is understandable, as at no point in the process does the system have a model or understanding of narrative structure, the characters involved, or pronoun agreement. Although capable of brilliance, the sample stories provided in the papers—presumably examples of the output at the system's best—read more like a Dada steam-of-consciousness monologue (not unlike an improvisational exercise proposed by Mick Napier [178]), or a game of exquisite corpse (described below in 3.1). Although the design of the system allows for local coherence between any two sentences, there are no mechanisms in place to enforce or encourage narrative consistency beyond the scope of individual sentences.

To be sure, working at the level of natural language is very challenging, and the fact that the systems manage to be as coherent as they are is a marvel worthy of praise. That said, without a wider scope of the player/author's artistic input, it is difficult for me to consider these systems as fulfilling the outlined pleasures of shared authorship pertaining to one's collaborator getting to know one; the system has no understanding of the type of story the user is trying to tell, and the corpus is so vast that the user has little chance of successfully anticipating the writing style, narrative voice, or even content suggestions of their writing partner. Perhaps of marginally less concern for us, but interesting nevertheless, is that *Creative Help* does allow for some amount of self-introspection, particularly in regards to the user/writer's relationship to their offerings, as the system keeps track of when the user altered the sentences it suggested using Levenshtein edit distance [123] between the user's input sentence and the retrieved sentence. This data was primarily collected to evaluate the system (as part of evaluating how much revision was required for the users to be happy with the sentences that it provided), but one can imagine future work in which the system uses this data to inform the decision process in fetching future sentences.

I also want to emphasize that even though this system is, strictly speaking, one of shared authorship (since both player and system are working in collaboration to create a story), the process lacks the "getting to know each other" pleasures inherent in my vision for shared authorship systems. This raises an important point that up to now has been left implicit: the process of working in a shared authorship environment is just as important as the product it is capable of outputting.

Before describing more authoring environments in greater detail, I think it will be useful to have a quick aside about a technique that many of them employ, and the implications that technique has with storytelling: procedural content generation.

2.1.2.3 Procedural Content Generation and Storytelling

As will be seen in subsequent system discussions, procedural content generation (PCG) is not, in and of itself, shared authorship. But as has hopefully been made clear through out discussions of *Tanagra*, *Say Anything* and *Creative Help*—all of which can be thought of as examples of procedural content generation—is that PCG is a technique that has direct application to shared authorship, as it is through PCG that a system has the means to not only respond meaningfully to user input, but to be able to "play along" and produce and shape artifacts of its own. The burgeoning field of PCG describes algorithms and processes that produce some type of artifact. These might be platformer levels, as was seen with *Tanagra* (a bevy of PCG work has been done with Mario levels [147, 298]), or gustatory delights such as recipes for food and preparation instructions for cocktails [197, 173], or architecture [176, 253], and lots more besides. Perhaps most relevant to the notion of shared authorship are applications of PCG in a story telling domain.

Reed's work once again comes to the foreground as someone applying these technique in novel ways for story generation[2]. As he outlines in his paper, promisingly titled "Sharing Authoring with Algorithms" [216], he discusses one of the fundamental tensions of applying PCG techniques to writing; namely, that as a writer, there is a desire to create something beautiful, and most PCG techniques applied to storytelling domains generally fall short of matching the quality of writing found in human authored content, see 2.1.3.[3] There are, of course, ample arguments for employing PCG algorithms, not the least of which is that by using PCG techniques one can create a quantity of content in an amount of time that would be difficult to be achieved by human authors. The tension, then, seems to be a trade-off between the desire for content to be easily generated, and for that content to be of "human" quality.

As one attempt to resolve this tension, Reed discusses an experiment in PCG storytelling called *Almost Goodbye*, which details an interstellar colonist's last day on Earth, conversing with the people they'll be leaving behind forever. In an effort to find a happy middle ground between these two conflicting desires, Reed took an approach in which the vast majority of the story content of the piece is actually written by himself; a human, and not just any human, but a professional writer. Thus, there is a reasonable guarantee that the bulk of the prose contained in the piece can be considered as

[2]Reed is certainly not alone in engaging with this kind of work. Nick Montfort [170, 171], Emily Short and Richard Evans [72], Khosmood and Walker [113], and James Ryan [233, 232] have also been working in the space of procedurally generating narrative content, to name a few others. I find Reed's works to be particularly useful examples to draw from in defining a philosophy of shared authorship, but my appreciation of his work should by no means be interpreted as a slight against the works of all these other luminaries!

[3]To be sure, this is a challenge that PCG techniques face outside of narrative domains as well; Michael Cook who, among other feats of PCG wizardry, has developed an artificial game designer that procedurally generates entire games, has some fascinating insights into how work is perceived when it is judged as a product of a human as opposed to the product of an algorithm [45].

achieving a certain threshold of quality.

The PCG, then, is responsible for handling "satellite" sentences of the piece. Satellite sentences are used for pacing and reminding the reader of the scene's context. These sentences do not drive plot or advance character development or relationships, but can help reinforce details that have already been established, and provide the story with a pleasant, thematically appropriate flow. When Reed writes about sharing the process of writing with an algorithm, he speaks of himself, as the author/designer, working with the algorithm which he himself developed. This is subtly different from previous examples of shared authorship I've discussed, as those were systems meant to enable end users/players/authors to create their own stories. Here, the collaboration largely takes place between system designer and algorithm, working together to present a final piece to the end user that does not require them to take on an authorial role, as the choices the player makes in *Almost Goodbye* is largely one of sequencing, determining the order the player's character says goodbye to loved ones. This design lends itself gracefully to showcasing the strengths of the system (e.g., with each successive person the time of day advances, but the satellite sentences generated will make whatever order the player chooses feel hand authored), but as I already discussed when examining hiring the pirate crew in *The Secret of Monkey Island* in chapter 1.1.1, simple sequencing decisions such as this tend to not yield ontological impacts on the narrative, and thus are difficult to consider works of shared authorship. And yet, the title still seems apt.

The secret that this paper brings to the forefront is that there are at least three roles involved in the development and engagement with a piece of shared authorship:

the system designer, the system, and the user. The system designer is responsible for developing the system; authoring the processes that give the system the capacity to meaningfully respond to user input, and to create any surrounding content or environment necessary for the user to engage with the work. The system is responsible for generating content, based on a combination of the processes authored by the system designer, and the input provided by the user. The user, finally, is responsible for engaging with the system, interpreting its output, and providing input.

Up to now, I have been describing pieces of shared authorship between user and system; the system designer's influence lives on through the system they developed, but they are largely removed from the collaborative process—at least through direct influence—by the time the system enters the hands of the user. What Reed proposes here is collaboration between system and system designer; creating an artifact that, though dynamic, does not allow ontological impact on the part of the user. This dissertation is primarily concerned with shared authorship between system and user. System designers are vital too, of course, as they are the ones developing the underlying technologies that make such systems possible (and indeed, a great remaining bulk of this dissertation will be describing such underlying technologies in the very near future in chapters 4, 7, and 8). That said, most of the pleasures of shared authorship described above were done with an eye for system-user partnerships, and it is this dynamic that I will be focusing on for the remainder of the text.

Please note that the use of the word user in the above description, though somewhat bland, is intentionally generic to encompass the diverse array of interactive experiences that might be considered pieces of shared authorship (players seem game centric, readers/authors feel more appropriate for pieces of electronic literature). However, as I'll introduce below in 2.1.2.4, I am willing to move away from the generic term of user when describing specific systems, as its generality will likely produce more confusion than it clarifies.

Speaking of which, I now move on to another tool for generating stories that follows a very different authoring process: *Wide Ruled*. *Wide Ruled*, as I will soon discuss, is a story authoring system that doesn't exhibit shared authorship, but this negative example is useful for further refining the concept of shared authorship systems.

2.1.2.4 Wide Ruled

Wide Ruled (and its unreleased progeny, *Story Canvas*), is an authoring tool designed by James Skorupski to help create a generative space of stories [265, 266], unlike *Say Anything* or *Creative Help*, which assist the user in creating a single story at a time. The generative space is then intended to be handed off to another user to enjoy. Because there are two sets of users (the initial author of the generative space who is *using Wide Ruled* and the recipient of this generated space who is *using* it to experience stories of their own), as well as two sets of creators (the first is once again the author of the generative space, the second is system-creator Skorupski himself), the terms user and creator are overloaded. Therefore, when describing these systems, and systems like them, I will attempt to adhere to the following nomenclature: a creator refers to the developer of the system (here, Skorupski), an author refers to the person that uses said system to create an artifact meant for others to experience, and a user (or player) refers to person who engages with said artifact. When I deviate from this breakdown, I trust the surrounding context will make clear to which of these three roles I refer.

To use the parlance previously established, the approach to authoring they enable is closer to Smith's use of the sculpting metaphor than Reed's sculptural fiction. The underlying technology powering these systems takes inspiration from Lebowitz' *Universe* storytelling system (described in more depth in 2.1.3). Authors of this system specify locations (which can, in turn, have any number of user defined attributes), characters (allowing similar customization), plot points, and story fragments. With these raw materials, players specify a story grammar[4]. In addition to higher level non-terminal symbols (e.g., START_STORY, ENCOUNTER_AT_INN, TRAGIC_REVEAL, etc.) which ultimately get expanded to much more specific terminal symbols (in *Wide Ruled* taking the form of natural language), the author can specify templated variables (such as determining at the beginning that one of the characters will be labeled as the "hero", and then consistently using them whenever a hero is referred to in the rest of the grammar). In addition to this, authors can specify narrative elements that can only be used if certain conditions are met. One might imagine that an author-defined character attribute might be their age, and an author-defined location attribute might be a

[4] In truth, this is less of a grammar and closer to a Hierarchical Task Network planner (HTN planner) [101]. The traditional story grammar is context free, with no ability to make use of preconditions. That is, any matching symbol is equally valid, with no means to specify preference for one over the other; HTN planners—and Wide Ruled specifically—include reasoning over preconditions to determine which symbols are eligible to be selected next. Moreover, as I will discuss shortly, Wide Ruled permits the ability for fragments to adjust internal story values, these values are then used in precondition evaluation. That said, the act of authoring in Wide Ruled is still very reminiscent of grammar authoring. Similarly, when a set of symbols have their preconditions satisfied, one element of that set is selected at random for expansion, which also adheres to the process of a traditional story grammar.

minimum age for entry (say, a bar only serving those twenty one and up). If a teenager is selected as the protagonist, then the stories generated would ensure that they never wind up traveling to the bar. As terminal symbols are reached, not only is text chosen to be appended to the story, but variables storing the state of the story can change as well (e.g., time could elapse and the character's age could increase).

Once the grammar[5] has been specified by the author, players can then generate many stories that match it. The stories are generated one terminal symbol at a time; typically appending approximately a single sentence each time. In between each of these concatenations, the system allows for author-defined interactions, which take the form of forcibly changing internal story states with some accompanying text (for example, swapping the hero out for another character by having them remove a latex mask, revealing their true selves). Were it not for this method of interaction, *Wide Ruled* would simply be considered a story generator. It would lack any form of a collaborative back-and-forth, and be more akin to building a machine which could then independently produce stories on its own.

This is not to say that story generators are "simple" by any means (please see 2.1.3). But they do only have a weak membership, if any, into the area of shared authorship. The interaction points enable a back and forth, as the user is able to change narrative values and then see how the system adapts to those changes. However, even this is not as collaborative as it could be, as once again all of those interaction points were created by the author of the grammar in the first place. In other words, the author has

[5] Or plan.

defined the space of possible stories and the interaction points, and the act of triggering an interaction point simply moves the story from one portion of that generative space to another. The output of this system still is more than capable of eliciting surprising results, and the system itself is capable of understanding narrative progressions and character arcs, but only in-and-of as much as the author has specified them ahead of time[6]. Thus, I feel that *Wide Ruled*, even with the capacity for interaction, is less an example of shared authorship, and more a tool to enhance one's memory and explore different paths than one would naturally be able to do on one's own. It is a useful tool that produces varied output (and often delight), at a faster rate than a human author alone would likely be able to, but all of its cleverness comes from the cleverness of the author when penning the grammar; all of its genius stems from the delicate arrangement of characters, their attributes, related interaction points, and how those are integrated into story fragments. It is the author's individual creativity that results in the expressive range of *Wide Rule's* output; the system merely obeys orders, and the player simply experiences the generative space laid out by the author. When it does have choices to make (e.g., there are multiple terminal symbols that could chosen), the choice is made randomly, rather than through any understanding as to which is more cohesive or narratively satisfying. With the author being at the forefront of the system's output, it seems that rather than collaborating with the system, *Wide Ruled* enables its authors to better collaborate with themselves.

[6]To recap: there is the Wide Ruled *author* that creates the grammar, and then possibly many *users/players* that might use the initial users grammar to generate their own stories. The above description applies to both types of user, though in slightly different ways, as I will discuss in just a moment.

For players engaging with a piece of authored *Wide Ruled* content, the degree to which the experience can be considered a piece of shared authorship depends heavily on the nature of how the piece was authored. First and foremost is the observation that a *Wide Ruled* story may not even offer the player any interaction points, and even if they do, they will not wait for players to make interaction selections and will simply be content to continue expanding the story to its conclusion; this attitude—if we ascribe an anthropomorphic trait to the system; appropriate if we are to think of the system as a collaborator—seems to be a dismissive one towards its human collaborators, the system happily producing stories without any player intervention or involvement whatsoever. This means that when the player wants to take action, they must do so swiftly, less they miss their opportunity to make a difference; this makes the interaction process a frantic one, rendering it very difficult to think about the repercussions of the player's actions. Moreover, though the generative nature of the system theoretically permits for uniquely crafted stories, every Wide Ruled piece that I have seen has felt more like the simple branching narratives described in Chapter 1; that is, the player is yet again not actually authoring their story, but merely selecting from a set of existing options to move the story down one of a limited number of paths; these paths, perhaps, will be realized in ways not explicitly written by the *Wide Ruled* authored due to its generative nature, but the overall structure of the piece will be adhering to that author's model of the story. Thus, though *Wide Ruled* is a valuable piece of interactive storytelling, it does not feel correct to ascribe it the label of shared authorship. The next set of creation tools I would like to discuss span authoring text, images, and more. In truth, they are less tools and more a design philosophy that I believe shares many values with shared authorship: Casual creators.

2.1.2.5 Casual Creators

Perhaps the authoring tools that best embody the spirit of shared authorship are *casual creators*, as proposed by Kate Compton [43]. Compton's inspiration for casual creators came in part from her work on the *Spore* Creature Creator [319], a tool which allowed users to combine limbs, facial features, and other bodily attachments to create aliens which then live and move on their own planet thanks to a procedural animation system. It was immensely satisfying for players to see their work come to life; engagement with the tool was playful, as there were certain rules that had to be adhered to, and only a limited amount of evolutionary advantages could be bestowed to the creature, so players had to pick and choose their creature's appendages wisely. Seeing the creatures tromp about their home planets was a delight; they were clearly a creation of the player's imagination and design, yet the life they took upon themselves was a direct result of the dynamic animation system and artificial intelligence procedures that the system provided. Player and system worked together to create life[7].

Compton has continued this philosophy in her own work into casual creators. Though her work spans a myriad applications, from jewelry designs that can be fabricated via a 3D printer [43] to games that help discover program invariants [42], perhaps the most

[7]Through personal correspondence with Compton, it should be noted that, while the *Spore* Creature Creator "caused the beneficial positive outcomes (ownership, pride, sharing) that casual creators should want to generate" she also took inspiration from other *Spore* creator tools that failed to reach its level of success, namely the Planet Creator and Adventure Creator, both included in the *Spore* expansion pack *Galactic Adventures* [320].

widespread casual creator to date is Compton's *Tracery* [41].

Like *Wide Ruled*, the expressive power of *Tracery* stems from a grammar. Again, users define symbols, non-terminal symbols expand to either other non-terminal symbols or terminal ones, and eventually the user is left with a string of terminal symbols. Although *Tracery* was originally conceived as a textual story generator, it has since been used in a variety of contexts, including emoji-based art, svgs, idle-games, and other forms.

Besides its flexibility, one of *Tracery's* greatest strengths is the ease with which developers can author for it, and the excellent tutorial located at [40] to bootstrap new users in thinking with grammars. *Tracery* has since been integrated into a variety of platforms and languages. This reveals an important lesson: never underestimate authorial leverage in the efficacy of a tool. Regardless of the expressive quality of its output, if no one wants to author for it, there will be no output.

However, as with *Wide Ruled* before it, *Tracery* is a tool that enhances the creative capabilities of the artist, without being a collaborator. It has facilitated the creation of some lovely output, but once again, that output is not a collaborative back and forth, but rather simply contributes an assembly of raw material that was provided by the author. This might be better illustrated by looking at my personal favorite piece of *Tracery* powered media at the time of this writing: a Twitter bot developed by *Ice-Bound* co-creator Jacob Garbe that sporadically tweets short plot synopsis of "leaked" episodes of the charming cartoon show *Steven Universe* [284].

Every episode it develops is a delight, but after reading dozens of these summaries, the underlying grammar rules gradually make themselves apparent, and many of the generated episodes are near carbon-copies of each other, save with small differences such as one character being swapped out for another. Though one can only derive so much insight into the overall system by exploring one simple use case (one can imagine a grammar with complicated expansion rules and a multitude of terminal symbols that make it difficult to "see the cracks" as it were and reverse engineer the grammar rule set), I still think this illustrates the idea that all of the authoring, creative effort for the user happened at the initial authoring of the grammar, and after that the grammar simply worked on its own.

This notion does, I suppose, fall apart a little if one entertains the notion that curation is part of the collaborative creation process; Garbe said that when the bot was first starting out, he cherry-picked the generated stories he wished to share with the world. This is certainly a form of collaboration, as the player/author involved is now responding judiciously to the output of the collaborator; choosing tweets to make public might not constitute a deep creative effort, but it is still certainly one that reflects upon both the human—sharing their good sense of taste and ability to identify quality content with the world—and their collaborator, by showcasing its capacity for generating content of interest. Here, then, although collaboration seems to be present, the sources for this collaboration are severely unevenly distributed, with most of the thought being done by the human[8].

[8]If one thinks of the "amount" of collaboration a system affords as a measurable unit, one can then consider the degree to which all parties involved contribute towards this collaboration total. This thought experimented is inspired by the notion of process intensity (or, in Crawford's terms, the Crunch-To-Bit ratio [48]), normally used to express the amount of computational/procedurally determined assets a game (or other piece of software) contains in relation to the amount of instantial assets (assets made by designers that are functional blackboxes to the system that resist influencing or being influenced by a system's procedures, often things like art assets, animations, and music) it possesses. It is poten-

Related to but separate from this idea of curation, seeing the output of the system can help inform the future development of the system. This is a notion that has been brought up in many contexts, including in the discussion of AI based game design [63]. This idea of reviewing a system's output, and taking inspiration from it to evaluate the system and iterate on its expressive capabilities is a valuable part of the general game design process [78], and can specifically be applied to evaluating shared authorship systems. As important as this act itself might be, it feels less like an inherently collaborative one in-and-of-itself, and more like the solitary act of editing and revising an essay, or watching a video of one's self playing tennis in hopes of improving one's form. Thus, I do not consider this action of iterative refinement to be one of collaboration. That said, iteration is still a very useful and important part of the game design process, and games with shared authorship qualities are no exception. For a deeper discussion on this, please see chapter 6.1.

However, though I have hopefully convinced you, gentle reader, that Tracery itself is not an example of shared authorship, that is not to say casual creators are in any means lacking. I merely mean to plant a flag in the ground that shared authorship and casual creators are separate research areas, concerned with addressing separate problems, while sharing some common goals and philosophies as well.

We have now discussed many examples of authoring environments, tools, and pro-

tially interesting to think of the latent "collaboration potential" of a system, and how the amount and distribution of processing intensity across all parties involved in the system contribute to this potential. However, since this thought experiment rests of the assumption of a system having a measurable "amount" of collaboration, which is a messy notion at best and an impossibility at worst, I won't pursue this further in the dissertation.

cedural content generation that have refined our understanding of shared authorship. Now, let us explore a specific facet of PCG that has potential applications for shared authorship that we touched on in our description of *Wide Ruled*: Story Generators.

2.1.3 Story Generators and Procedurally Generated Narrative

Possible worlds are a fruitful lens through which to view story generation projects, as has been demonstrated by books ranging from Marie-Laure Ryan's *Possible Worlds, Artificial Intelligence, and Narrative Theory* [241] to Noah Wardrip-Fruin's *Expressive Processing* [309]. Rather than the single successful world embedded in many game designs, these systems are capable of producing many worlds—with significant variations in the system's areas of dynamism—both as final outputs and in the process of generating these outputs. It seems, then, that the incorporation of a story generator could likely be of great utility towards the creation of a piece of shared authorship. After all, as I discussed back in chapter 1.1.1, one of the most grievous cases against *Monkey Island* being an example of shared authorship (and questionably an interactive narrative) was the fact that it only consisted of a single, static narrative experienced by all players.

Borrowing from story generators might provide clues to help alleviate that problem in future works. I'll begin by discussing three different story generators here: *Tale-Spin*, *Universe* (already briefly discussed in 2.1.2.4), and *Minstrel*. I'll then describe some of the lessons systems such as these can teach us—both for shared authorship specifically and interactive storytelling in general—as well as describe other systems that have attempted to leverage those lessons (and what, in turn, those later systems have to teach us as well).

The worlds of *Tale-Spin*, by James Meehan, are populated by bears, birds, bees, and other woodland creatures, and center around the satiation of needs such as hunger, thirst, and fatigue. Though the denizens of these worlds might appear to be simple animals, they make use of an intricate belief system, theory of mind, and basic relational attitudes to achieve their desires [165]. Ryan notes that the program follows the pattern story = problem + attempted solution [241] and produces narratives by foregrounding a character's internal goal and attempting to satisfy it. If, for example, a bird character doesn't like a bear character, but believes that the bear likes him, he may promise the bear a hypothetical possible world in which the bird provides the bear with some honey in exchange for a worm. If the bear follows through with this deal, the bird will reveal the counterfactual nature of his promise, gobbling the worm while leaving the bear hungry. Versions of *Tale-Spin* did allow for some amount of user intervention (e.g., specifying the central animal, and the problem they faced), but it was largely a passive experience on the part of the reader.

Michael Lebowitz's *Universe*, generates stories in the genre of the melodramatic soap opera. These stories are "from the perspective of the author rather than that of characters" [241] populated by characters described by arrays of traits (e.g., scores for intelligence, self-confidence, and moodiness) and a family history. The actions of the characters, however, are determined by author level plans. Characters are selected that fit the criteria of a plan; for example, an arranged marriage plan might require two parents from different families, both with children of suitable age for marriage. Multiple runs through the system might choose a different set of characters for the plan, or possibly different plans entirely, resulting in several different potential narratives, each a possible world in the universe of *Universe*. Astute readers may recall that this was the system used as a foundation for the previously discussed *Wide Ruled* tool from 2.1.2.

As discussed with *Wide Ruled*, this story generation tool models how an author might approach writing a story. This is perhaps best illustrated with the author-level goal “Churn” which specifically takes happy, satisfied characters and causes them to take actions with the intent to disrupt their lives. Humans, as a rule of thumb, tend to avoid purposefully negatively impacting our lives, but one can easily imagine an author intentionally introducing conflict for the sake of drama. Still, though it generates its prose from the viewpoint of an author, *Universe* bears fewer qualities of shared authorship than *Wide Ruled*, as the original system did not afford any input from the user.

Minstrel, developed by Scott Turner, employs the artificial intelligence technique of Case Based Reasoning to generate stories. Given a corpus of starting stories, *Minstrel* uses author specified transformation policies, called TRAMs, to combine like elements from separate stories to produce a new tale [301]. For example, if one existing story involves a knight slaying a dragon with a sword, and another has a knight defeating a troll with poison, *Minstrel* could produce a third story in which a knight bests a dragon with poison. Like *Universe*, *Minstrel* also had mechanisms attempting to mimic an author’s writing process through Author Level Plans, or ALPs. These ALPs would attempt to tell stories that ascribed to an Aesop’s fable-esque moral. Once again, the stories generated by this system could be considered shared authorship only through the raw material (e.g., the cast of characters, TRAMs, ALPs, and some hand-authored stories that make use of them) specified by the author for the system to make its start. The idea of the system building upon its own corpus of work to develop additional stories is an intriguing example of computational creativity that certainly could have applications to a shared authorship context, but is difficult to consider an act of collaboration in and of itself.

The possible stories that could be produced by these systems are varied and vast and are generated through sophisticated models of characters and authors alike. But in an experience that Wardrip-Fruin has termed the "Tale-Spin effect" [309], this rich possibility space is never translated into an audience experience, leading users to mistakenly believe that the sophisticated systems are not even present. Instead, the output of most AI story generation systems does less to prompt the imagination of further possible worlds in the audience than a middling plain text fiction. And with little to no opportunity for the audience to affect the output of these systems, engaging with them is an act of consumption rather than collaboration. *Universe* and *Minstrel* might be modeling authors, but they are specific incarnations of authors that are singleminded in their writing, and neglect to open themselves up to the feedback of potential collaborators.

Story generators such as these clearly have potential applications in shared authorship; having a digital writing partner engage in the authorship is an important component of shared authorship and story generators are all about a computer program that can write. However, these systems would either need to be augmented with facilities for user interaction (though even that does not guarantee a collaborative experience; see

Wide Ruled above), or themselves applied to another system. One such example of this is a rational reconstruction of *Minstel* (née *Minstrel Remixed*, later *Skald* [294, 293]). Though applied in the service of making an interactive game, the developers of this system and this game struggled to make the generated stories of *Skald* be of the narrative caliber they were aiming for.

This raises an interesting point, and one which ultimately rests with some amount of subjectivity. I've now discussed several procedural content generation systems in which the quality of output was either a central concern for the system designer, or was not, to the detriment of the system. Yet when discussing the pleasures of shared authorship, quality of the output was less important than the sense of feeling that one's artistic voice was being heard in chorus with a collaborator. Something left out of the explicit pleasures, yet clearly very important to a work of shared authorship, is the belief that one's collaborator is good to work with. What makes a collaborator good to work with will differ for different people; some might be willing to trade quality of output for a partner that does a good job of listening to them and allowing their own artistic aesthetic to be visible in the final product. Others might value the quality of output above all else, and would rather abandon a creative partner and work by themselves, if they perceived it to have a net positive impact on the final output.

The Tale-Spin effect plays an interesting role in works of shared authorship as well; as the perceived effort level of one's collaborator can have an impact on their perception of their contributions. If one believes that a collaborator is not trying, one will be less inclined to be impressed by what they produce. There are, of course, savants capable of producing genius with seemingly little effort, and there are those who despite years of training still struggle with their craft. Regardless, their is a general correlation between effort invested and quality of output (and even without quality of output, the effort itself that went behind it is often a source of appreciation in and of itself). The Tale-Spin effect describes situations in which the internal processing is invisible, even though it might be there; because it appears that *Tale-Spin* is not "working hard" to develop its stories, it becomes more difficult to appreciate them.

This phenomenon is exposed even more deeply when one takes into consideration *Tale-Spin's* "misspun" tales. These stories often result in glimpses into the underlying system: one of the most well known of these tales reveals that the notion of gravity was encoded in the same representation as a standard character. As such, gravity was subject to the same perils an average character faces. When one story took a surprisingly twist when the system produced the sentence "gravity drowned," it not only delighted through its unexpected absurdity, but exposed the existence of a model for gravity, which otherwise was not readily apparent through reading the typical output. This is further evidence that exposing the inner machinations of works of shared authorship—exposing how their thought process is carried out—can potentially have positive effects in building up a rapport with the system, which is quite important for developing a collaborative relationship.

More works of shared authorship will need to be developed to be able to determine the different types of users of shared authorship systems, the values they have, and the relative tradeoffs they might experience between such concepts as the quality of output and the rapport between themselves and the system. For now, I simply accept that quality of output is an important consideration to a degree for all players, but is secondary to the primary pleasures regarding the sensations of collaboration and construction.

2.1.4 Choice Poetics

I've spoken about choice based narratives, such as *Mass Effect*, and how there are some qualities to them, fundamental to their nature, that clash against some of the ideals of shared authorship. However, the prolific amount of choice based narratives that continue to be created speak to their ability to capture the imaginations of those that engage with them. It is understandable, then, that there must be a wealth of artistry that goes into making and designing choice based narratives.

In an effort to greater understand the phenomenon, Peter Mawhorter has begun work on developing a choice poetics [148], providing a lexicon with which to speak about choices in branching narratives, the different types of choices often found in such narratives, and the impact that including any given choice might have on the resulting story. For example, Mawhorter defines the "false choice" and "dilemma" as two example choice structures. In the "false choice", players are apparently given choices that will alter the course of the story, but in actuality all potential options lead to a functionally similar result (similar to the beads on a string model examined in chapter 1.1.2). In the "dilemma" players are given a difficult choice in which there are no clear "good" answers; all options will likely lead the player to a state of regret.

In addition to laying out the groundwork of choice poetics, he has developed a system called *Dunyazad* that is capable of generating choice-based branching narratives. Relative to the generators already discussed in 2.1.3, this is an exciting step forward towards generating works of shared authorship. Here, the prose being generated is not merely meant to be read, but the player takes an active role in shaping the plot. That positions this system in an interesting middle ground between *Universe*, *Tale-Spin*, and other story generators that generate prose meant for simple consumption, and games requiring active participation to advance the story such as *Mass Effect* or TellTale's *The Walking Dead* [306], or even flipping to the appropriate page in one of the many novels in the Choose Your Own Adventure genre[9].

As previously discussed, choice based narratives typically consist of a finite set of possible paths which, given enough users, will eventually all be explored many times over. The possibility of a system generating choices, however, gives the system the theoretical ability to create an infinite number of distinct branching narratives, finely tailored based on the choices made by an individual player. This is much closer to the ideals of shared authorship; assuming a system that was generating choices that reasonably followed the causal chain of events determined up to that point by the

[9]The phrase Choose Your Own Adventure was used in 2.1.1, but I realize I may have left readers unfamiliar with that particular genre of story in the lurch. Basically, a Choose Your Own Adventure novel is like a traditional book in many ways. However, as the protagonist comes to key decision points in their story, the book describes the possible options the protagonist can take, each with a corresponding page number. The reader "makes the choice" on behalf of the protagonist by flipping to the page number attached to it; on that page, the story resumes as if the protagonist had come to the same decision of the reader. I say the choice is one made by the protagonist here because these books frequently frame the reader as the narrative's central figure; however, this framing is less central to the form of the Choose of Your Own Adventure than the act of diverging the narrative based on flipping to a particular page.

player was at work, the system and player would indeed be working with each other to tell a story. The player would select a choice, the system would interpret that choice and advance the narrative eventually leading to another choice, which the player would make, which in turn would inform the system of possible ways to direct the narrative, presenting the player with another choice, until at last either player or system (or both, in agreement) determine that the story has reached a natural conclusion.

Though choice poetics, and specifically *Dunyazad*, promises an exciting direction in which to take this work, there are of course some notable limitations. This system uses the same tool of Answer Set Programming that Smith used in *Variations Forever* (see 2.1.1). In order for this to work, there needs to be some amount of base authoring done by the system designer of potential "atoms" that the system can reconfigure; in *Variations Forever*, these atoms were game mechanics and aesthetics; in Mawhorter's system, these are character actions and a world model (e.g., only evil people will attempt to poison another, only poisoned people can be cured, etc.).

This notion of authoring burden, and the need to address it, is well known [37]. The traditional tactic to overcome it is to simply throw a bevy of human authors [299] at the problem, though even with teams of dozens of professional writers working for multiple years, the amount of content capable of being produced will be finite. However, as seen through the various story generators discussed, instead of creating a handful of instantial, static stories, one can instead opt to create a generative space of content which a system can reconfigure to produce a great many stories.

The current implementation of *Dunyazad* has a relatively small amount of raw authored material with which to work, meaning that the total generative expressive space is at present relatively small. It also, arguably, does not expose enough of its inner workings to the player, placing it in danger of succumbing to the Tale-Spin effect. Looking at that last point through a lens of shared authorship (which does, I admit, require some indulgence on the reader's part, as that was certainly not the lens through which the system was crafted), it makes it difficult for players to feel as if they are getting to know their collaborator and are working with them to produce the final narrative. Regardless, as a thorough examination of something which is often taken for granted, and as a system that combines generative power with meaningful player interaction, choice poetics and *Dunyazad* are inspirations, and offer very promising fertile ground for future work.

2.1.5 Fostering Human Collaboration

Since collaboration is clearly such an important part of the shared authorship experience, it seems fruitful to find inspiration in digital tools that have been developed to aid human to human collaboration.

2.1.5.1 Through Competition

Some of these tools that facilitate human-to-human collaboration are game-like in nature. One such example is the game *Collaboration*, by synthetic-reality.com [251], which was inspired by the game *Y.A.R.N*, part of the MPlayer gaming service born in the early days of networked multiplayer gaming (so early they have a patent on "online gaming architecture" [229]). In both of these games, players all vie to contribute the next sentence of a story. Individually, players write a sentence. Once everyone has written their hopeful contributions, each sentence is anonymously presented to all of the players, who are then asked to vote for the sentence they would most like to see appended to the story; the sentence with the most votes wins. To encourage good writing, and good behavior, points are awarded for each vote received (so even contender sentences that do not win still propel their authors closer to victory), points are awarded for voting for the winner (so as not to encourage throwaway votes), and no points are awarded for voting for one's self (to encourage being a gracious player, supportive of one's fellow authors). The system, in these games, had no internal understanding of the stories being created; it merely enforced these simple rules.

Even without an understanding of the narrative content at play, these interfaces and rulesets were capable of bringing many fledgling authors together to share ideas and write stories that were, most assuredly, collaborations. Even if an author was unfortunate enough to never receive enough votes for their sentence to be accepted as the next contribution, all of the other players would still be exposed to their prose, and thus be affected by them, which in turn could potentially influence the next sentences the other authors chose to contribute. Thus, all collaborators involved—if not directly contributing to the story—were contributing to a soup of ideas from which every player drank.

Thus, as was seen in the description of agency and *Checkers* in 1.1.2, competitive environments have the potential to provide players with unique forms of authorship over an experience. Moreover, *Y.A.R.N* leverages the human capacity for storytelling; it is an experience in which a digital interface facilitates and structures human-to-human interaction. Although this dissertation is primarily concerned with developing computational technologies that enable shared authorship, making use of the human capacity to recognize and tell stories can be a powerful tool, as I will cover in greater detail in chapter 7.

The competitive aspect to the game, it could be argued, does run counter to the collaborative spirit the game intends to foster. If you, gentle reader, seek an example of digital-interface facilitated human-to-human collaboration sans competition, look no further than Jason Rohrer's *Sleep is Death* [227].

2.1.5.2 Through Construction

Sleep is Death is a prime example of pure, technologically assisted, human-to-human collaboration. In this game, two players take turns creating, spinning, and elaborating a story. Both players are presented with an interface full of sprites representing characters, set pieces, and props; as well as additional mechanisms to advance story and establish tone and mood such as dialogue bubbles for character speech and music options. One player takes on the role of a director, and has the ability to manipulate all of the above to create a setting and populate it with characters. The other player is in control of just a single character, but it is agreed upon that it is that character that is the protagonist of the tale. The two players take turns affecting change on what they have jurisdiction over, directly inspired by the choices made by the other player immediately before.

Once again, the game has no semantic understanding of the underlying narrative that is being created. In some sense this is supremely liberating; humans, after all, are the ones who possess an innate understanding of what it means for something to be a story [162], so why not simply get the computer out of the way and free the human players from the restrictions on the story that interactive narratives so often impose? The theory of shared authorship sympathizes with this stance insomuch as it agrees that more often than not the player is stuck only experiencing or determining stories within a system's capacity to provide players with actions. However, to simply call interactive narrative a solved problem by creating systems that enable humans to tell stories with each other abandons the dream of a computational collaborative partner, a dream that provides much of the impetus for this dissertation.

Inspiration can without doubt be taken from these experiences that so effectively encourage humans to collaborate with other humans. However, these experiences do not constitute a solution to the challenge of shared authorship, to the challenge of interactive narratives in which player and machine collaborate to create something which neither would have been capable of producing on their own.

2.1.6 Planners

One major thrust of interactive storytelling has involved adapting planners for use in storytelling domains. Though there is a long history of plan based systems, with many exciting developments over the years [33, 68, 190, 221, 223], there are many properties that most of them share. A planner, as the name implies, attempts to create plans.

These plans can take many forms; we have already discussed one such application in the form of story generation (see section 2.1.2.4). Planners have also often been used in the service of drama management. I'll discuss a broader overview of drama management in chapter 2.1.7, as well as present some planner-specific drama management applications in this section. By talking about planners as a whole (instead of, say, in the specific context of story generators which have already been discussed), I hope to introduce yet another technique that enables a system to reason over and make moves upon an evolving narrative, and use this as a vehicle to address additional hurdles that systems supporting true shared authorship must overcome. Though there are many metaphors for entities that are generating plans, it is perhaps most straightforward to think of the plans as being generated by a character. That is, if the character in question is given some goal, how then, are they to achieve it through planning?

The answer is through finding a sequence of steps that ultimately has the character arrive at their intended goal state. Each step, though, has its own set of preconditions and effects. That is to say, there are certain things which must be true in order for the step to be carried out, and the effect of carrying the step out might have repercussions on the character themselves or the world around them.

For example, a simple plan might involve a character wanting to eat pizza. In order to eat pizza, a character must first have pizza; if our character has no pizza, they then must devise a means to acquire one. They might think to use their phone to call their local pizza parlor, but perhaps the phone is in the living room (let us pretend our pizza lover is one of those rare individuals without a cell phone), and our hero is in the kitchen. Our hero must devise a plan to get themselves from the kitchen to the living room; walking will likely do the trick. So, here, we see a small sliver of how plans can work; the act of using a phone requires being physically co-located next to a phone (e.g., that is its precondition), and so the character in this hypothetical had to take a separate action (something along the lines of "walk-to-living-room") that, upon successful execution, would make them lose the status of being in the kitchen, and make them gain the status of being in the living room (and, thus, able to finally call the pizza place). One can imagine similar prerequisites and actions for answering the door, finding one's wallet, paying the delivery driver, and ultimately enjoying their dinner.

If this example seems reminiscent of the hungry animals of *Tale-Spin*, it is because they too used a planner to determine their actions to achieve their goals. Just replace pizza with honey, and our—presumably human—hero with a bear, mix in some theory of mind, and la voila, *Tale-Spin* has been achieved.

Some planners have specifically been employed in narrative settings, with many agents formulating plans in the service of telling a story. Imagine if in our pizza plan scenario, our hungry hero was only a single character out of many in the world, all of whom were constantly reevaluating plans. The pizza delivery driver would be driven by the plan to deliver the pizza, because it enables them to get paid. Perhaps they want to get paid because they are saving up for an engagement ring to give to their sweetie. Perhaps said sweetie wants to see their beloved delivery driver all the time, and so they constantly order pizzas in hopes of summoning them. Plans can interweave in complicated ways, sometimes being diametrically opposed to one another, which can form the groundwork for exciting stories.

Plans can also work at a level above individual characters; such as the Author Level Plans present in *Minstrel*. Here, the system might have broad, general plans for the sweep of the narrative. For example, one such plan might detail the journeys of a wandering adventurer. The plan might begin with this adventurer entering a particular village. Once there, they will then learn of the many dangers besetting the town from the village elder. Finally, they discover the legendary blade resting at the bottom of the lakebed that will enable them to fulfill their destiny. On the whole, this seems like a pretty reasonable plan.

As is so often the case, though, things get muddier once a player with the gift of agency enters the mix. What if the player decides to visit a different village? What if they happen to find the lakebed sword first before speaking with anyone? What if they cruelly use that sword on the village elder before hearing about the non-player-based threats to the town? Any one of these choices made by the player could potentially seriously disrupt the envisioned narrative for the game.

This speaks to what many consider to be a fundamental tension between game and story; if the game is attempting to tell a particular story, but the player has the capacity to completely derail it, then one straightforward solution is to simply remove that capacity. This more often than not takes the form of placing limitations on the abilities of the player to meaningfully impact the narrative and the game world (e.g., there is only one village that exists for them to visit, as soon as they visit they are presented with a cut-scene of the elder greeting and bemoaning to them, swords aren't allowed to be drawn in town or on characters deemed to be friendly, etc.). To use our agency vernacular from 1.1.2, the game might still have just as many formal affordances as before, but the narrative is preserved by curtailing the player's material affordances.

But seeing as agency is one of the chief properties of games that distinguishes it from other storytelling media, reducing the amount of agency feels like a disservice to the medium. Some, then, have argued that storytelling has no place in games. This is, I feel, a pretty extremist view to take, and thankfully this ludology vs. narratology debate has largely been resolved, with both parties agreeing that the space for games is big enough to warrant titles with deep narrative elements (several of which have already been discussed throughout this dissertation). However, the initial issue that provoked this line of thought remains: how can one attempt to preserve player agency in an interactive digital experience while still enforcing a specific narrative, plot structure, or overall arc designed by the game developers?

The use of planners has been one such attempt to achieve this middle ground. Although planners have been used in a variety of ways to do this, one methodology is that of mediation. Mediation comes in two particular flavors: accomodative mediation and proactive mediation [96, 225]. Accomodative mediation is an attempt to repair plans that the player has broken. For example, in the wandering adventurer scenario, let us say that the player manages to insult the village elder prior to learning about the surrounding threats, but the plan requires that the player learns about these threats before moving on to the next item in the plan. Thus, the planner employing accomodative mediation might have the capacity to recognize that there are other people in the village (shopkeepers, fishmongers, playing children, etc.) that could accomplish the same job, and pick one of them to fulfill the responsibility originally designated to the elder.

And at first glance this does, indeed, seem like a happy compromise between gameplay and narrative. Here, the player was able to take the action that they wanted to take (i.e., insult the elder), the action seemed to have meaning (i.e., the elder no longer wanted to interact with the player), and yet the narrative as originally envisioned mostly still played out (i.e., the player learned of the town's situation from someone else). All the while, the player is likely none the wiser that any of this transpired behind the scenes; as far as they know, every player ends up engaging in a conversation with a fishmonger. If one's goal as a game designer is to create a world in which a specific story gets told, but that the player has a high agency experience that could disrupt the narrative—or the lives of the NPCs meant to further it—then accomodative mediation is a powerful tool to achieve this.

However, it does assume that there exists an underlying, established narrative, that is being told to the player. This is in many cases a reasonable assumption to make, and many games likely are written with the intent to achieve this goal; as discussed in chapter 1.2, it is a common argument that as the developers of media, it is our responsibility to be the storytellers that weave what the player ultimately experiences. However, shared authorship shies away from this assumption; in an ideal work of shared authorship, there does not exist an underlying story that is trying to be told; rather player and computer are creating the story together in real time. Under such a philosophy, accomodative mediation struggles to make sense; how does one repair a plan when the plan does not exist yet?

Now, there is perhaps some fruit to be had in formulating plans that are, themselves, subject to vast change. For example, a system working with author level plans, but that has the capacity to revise the very type of narrative being written based on the input of the player. As a simple example, the planner might originate believing that they are trying to tell a horror story, and fill it up with the components that define a work of horror (for a comprehensive list of such elements, look no further than [31]). However, as the player begins to make adjustments to the narrative, the "repair" to the plan is not to force the notion of horror onto the narrative, but rather recognize that the player is creating a story of an entirely different nature (romance, musical, you name it). A planner employing accomodative mediation at this level could be said to be engaged in shared authorship. In the examples discussed above, however, the planner provides local agency on the part of the player (sometimes referred to as surface agency [100]), but, the overall structure of the experience remains firmly outside of their control.

Proactive mediation similarly adheres to a pre-authored narrative like its accomodative counterpart, but depends upon mechanisms—often of a Dues ex Machina nature—to steer the player's path towards the original authorial intention by obviating player's actions that would irreconcilably disrupt it. Though as I will discuss shortly, the system's moves can still be diegetically framed, the cost to the player's agency is difficult to mask.

In proactive mediation, the system recognizes if a player's action is about to violate a component to the plan, and then prevents them from doing it. Returning to our wandering adventurer example, it was the act of insulting the village elder that made them clam up, and required a repair to the initial plan to advance the narrative. In this hypothetical example, insulting appears to be one of the affordances of the player. The player, then, would likely notice if—after wandering the country side, insulting inconsequential NPCs to the heart's delight—they finally stumble upon an NPC whose opinion of the player actually matters and, lo and behold, their ability to insult is suddenly nowhere to be found. Or they can insult them, but Deus-ex-Machina-esque extenuating circumstances prevent the insult from being successfully carried out (the player is struck with a sudden case of cottonmouth and cannot form the words, a noisy gust of winds clatters the window shutters drowning out the player's barb, the list goes on).

These "solutions" can easily interject new planning problems; if the player suddenly lost their ability to speak to prevent the insult, does that mean that now they cannot speak with anyone? If so, any plan involving dialogue between the player and another individual will need to undergo repair, as the player is no longer capable of fulfilling this function. If it was a gust of wind that blows whenever the player attempts to insult the elder—but at no other time—then the player will fairly quickly be able to successfully interpret the situation as one in which the game simply does not want and cannot allow them to insult this particular character. Perhaps the game is cleverly structured in such a way that the player only has the ability to insult the elder a single time, but then the convenient wind blows, the convenient shutters clack, and then the elder—oblivious to the narrowly avoided vicious verbal lashing—proceeds to communicate with the player.

But here, once again, the system is imposing a specific narrative experience upon the player, the pretense of agency merely an illusion.

Moreover, it is an expensive illusion to maintain, as surely this elder is not the only important character that figures into plans; similar contrivances to our wind and windows would need to be devised to prevent the player from insulting every character that is necessary to move the narrative along. And this is of course all just supposing that insulting is the only mechanic in the game that will render an otherwise friendly character disinclined to help. Combat features prominently in many games; would similar diagetic mechanisms be instituted for physically assaulting these characters? Poisoning their coffee? Hiring assassins? The amount of authoring energy it would take to convincingly maintain the facade that the player does, in fact, have agency in these circumstances is immense; and arguably is energy that should be spent making the game itself actually more amenable to player action.

I realize that the situation I describe might seem somewhat facetious; clearly many games find ways to prevent player behavior from spoiling the grand vision of the narrative the game has in store for them; the village forbids outsiders from drawing weapons, and thus the button on the player's controller that would normally pull out a sword now does nothing. But still, even these are impositions to agency and shared authorship; the game is basically making a determination of the personality of the player's character—in this case, that they are law abiding—that the player has no means to voice otherwise; the formal and material affordances are out of balance.

Systems that rely on plans have a powerful potential for striking a balance between player agency that games afford while telling a specific story created by the game designers, and thus are an extremely exciting area for interactive narrative research. However, a writing partner with an unwavering plan—that might take input from others only to further serve their own plan—could at worst be considered a bully. Therefore, unless the plans themselves are deeply malleable, such as described above, or the specific aesthetic framing is working with a collaborator single-minded in the direction they wish to take the story, it is difficult to envision planning being a basis for shared authorship. The best counter-argument that I know of is to treat overcoming the machinations of a planner as a puzzle to solve. Such puzzles may be an interesting design space in and of themselves, as shown by the game *The Best Laid Plans* [311] which asks players to put together a plan to accomplish a goal in a dangerous world full of NPCs with plans of their own trying to stop you. Though this feels more like competition rather than collaboration as the player and system are actively trying to thwart the other's agenda, it is a prime example of player and system revising their contributions towards a specific end goal.

In this section we have discussed planners and the potential issues involved in using character and story-level planning to support shared authorship. The next section explores the potential for drama managers — systems that manipulate the story world so as to maintain an experience arc with desired qualities of consistency, coherence and quality — to support shared authorship.

2.1.7 Drama Managers

I have discussed planners in 2.1.6, but planners are not the only higher level device that have been developed to ensure sound story structure. Drama managers are another tool that have been developed to ensure pleasant, highly dramatic pieces of interactive narrative. Drama managers primarily perform two major functions. Firstly, they sense the current state of the world, figuring out where players are physically located, how far along they are in terms of the story, what items or enemies might be close to them, what plot points they've hit and clues they've uncovered, and what still remains to be discovered.

Secondly, they have the means to interact with the game state, adjusting it to suit their needs (or, more precisely, the perceived needs of the player). The types of interventions can be as simple as having a character casually mention a clue as to what the player should do next, or can be as far reaching as rearranging the geometry or layout of the world. In general, drama managers are implemented to value subtlety; they are a quiet butler fastidiously toiling away out-of-sight to optimize the player's experience. Shifting continents might sound intrusive to the player's experience, but if the game began inside a house and the player had yet to go outside, they would be none the wiser that a seismic shift has transpired.

A Drama Manager makes these interventions to achieve very specific aesthetic or narrative effects, the exact nature of which depends deeply on the game into which it has been incorporated. For instance, in the action adventure game *EMPath* [285], the developers decided that they wanted players to focus on a single quest line at a time, but these quests could be encountered in any order. Once a quest was started, the drama manager would rearrange game objects to make objects pertaining to the player's current quest closer, and objects pertaining to other quests further away. This had the dual effect of keeping players occupied in local areas of the map, as the designers of the game (and its drama management system) determined that they did not want players to feel like they constantly had to criss-cross back and forth across the entire game world, but rather experience related plot points in constrained areas of the map. This minimized the amount of back-tracking, without arbitrarily limiting the agency of the player.

As the player explored new areas of the map, however, the drama manager's ability to influence the world was gradually reduced. This was because, as I mentioned, the drama manager was meant to be neither seen nor heard. Let us imagine that the player is growing frustrated after not being able to find the final item for their quest. The drama manager senses this frustration (perhaps by observing that a lot of time has elapsed since the previous item they found, and the player is crossing great distances revisiting old areas to no avail) and wants to help the player. The most direct way to help the player would be to simply teleport the quest item in front of them. Though this may alleviate the player's frustration, it could potentially cause even worse problems: it obviated all of the player's searching, it denied the player the thrill of discovery, and unless the object was imbued with magic or some other such power, its materialization broke diegetic realism. This direct meddling is called out by Nelson in [181], arguing that the drama manager should take pains to track its own manipulativity, and take pains to minimize it[10].

Slightly better than this would be to teleport the object to a nearby location outside of the player's direct line of sight. But what if the drama manager chooses to bring the object to a spot of well trod ground, that the player has already visited many times in their search? Perhaps the player might curse themselves for simply not seeing it the first (several) times, or perhaps they might curse the game for feeling like it cheated them. Thus, the drama manager must strike a balance between not violating the player's perception of the game world, yet still making interventions to improve the quality of the experience (in this case nudging the player to help them become unstuck). The nature of the game, and the means of available intervention, can make these interventions easier to narratively justify than moving items around. For example, if the player is attempting to find another character, after enough time of stumbling around, the drama manager can have that other character "find" the player instead; teleportation of game objects is easier to swallow when the game object in question is capable of locomotion.

Drama management techniques have been employed in a variety of other systems, including interactive fiction [180] and a 3D science education game [230]. Though perhaps one of its use cases most true to its name was in the interactive drama *Façade*

[10] Similarly, rather than enforce a given narrative, Nelson proposes that drama managers also track the "choices" available to players as a measure for how much power they have to shape the course of their own narrative. A drama manager that does not take choices into account is likely to collapse or otherwise remove all branches that it deems less than the best, ultimately lineralizing the experience across multiple playthroughs. By valuing paths that permit the greatest amount of player choice, it ensures (or at the very least, greatly increases the probability) that many paths will be available to players at any given time, permitting them to chart their own narrative course.

[280], where it was used to ensure the unfolding drama adhered to a nice Aristotelean dramatic arc [6], the basic idea being that a good story consists of rising action, culminating in a climax, and closing out with a gradual denouement. *Façade's* drama manager picked from a pool of narrative beats for its characters to engage in that fulfilled certain dramatic requirements, such as building off of information established earlier in the playthrough, and bearing a dramatic rating appropriate for the current point in the dramatic arc.

There are two points I'd like to discuss about drama managers in the context of shared authorship. The first is considering the drama manager as collaborator, adjusting and affecting the state of the world as the player engages with it. The second is thinking of the drama manager as a storyteller, as a mechanism for encoding the developer's conception of a "good" story. These ideas are woven together in many experiences, in which the drama manager acts upon its understanding of good narrative to inform its interventions, but they do not have to be. One can imagine an experience in which the drama manager makes no interventions, silently judging the player's actions but unmoved to alter them. Conversely, it is perhaps even easier to imagine a system unintelligently making maneuvers without rationale.

Since drama managers can take meaningful actions that affect the game world, they seem like very fruitful territory to explore works of shared authorship. However, drama managers often work in the shadows, and revealing their existence can detract from the player's enjoyment of the game, as was discussed with our quest object teleportation example above. This is a very legitimate concern, and yet it almost frames the drama manager with an obsequiousness that makes it difficult to imagine working with, at least if the goal is to evoke the feelings of creating with a partner (as it is in the case of shared authorship). Thankfully, this is more a matter of framing than any inherent problem with the metaphor of drama managers themselves; the game itself (and, perhaps, a lifetime of associations formed by the player through playing games in similar genres) is responsible for setting player's expectations. If a game tells the player to hunt for items to satisfy a quest, most players will assume that it will only be through their efforts that the item will be discovered, and it is the violation of that expectation which can cause vexation when the drama manager makes itself known.

If, however, the game frames itself as one in which there is a drama manager, casting the system as a character, as it were, to be engaged with and worked with, suddenly the interventions are no longer violations of the player's expectations, but are instead integral movements in the game. Thus, the metaphors of drama managers are excellent seeds through which to develop pieces of shared authorship.

With regards to the second point, drama managers as a means of understanding what a good story is, it is hopefully apparent to the reader how useful a tool this is, though admittedly, a tool which requires a good deal of knowledge representation pertaining to the details of the game's story in question. Still, a shared authorship experience must have some means to understand what constitutes a good story; the metaphor of a drama manager's sensors to perceive the current state (or quality level) of the story adheres to this very nicely. Moreover, if the story has been operationalized to the point that the drama manager can reason over it, then it is not so far a stretch to imagine that the drama manager's values themselves are malleable. This is an exciting aspect of shared authorship; that the system not only has an understanding of the story and has desires to impact the story in hopes of improving it, but that its perception of how a story can be improved changes over time through—in a charming reversal—the intervention of the player. One can imagine a game in which the player takes on the role of a writing tutor, the drama manager is embodied by their pupil, and the player attempts to impart their narrative wisdom upon their young ward through collaborative writing and the editing of the system's output. It will take some time before advances in natural language processing would allow for this game to be realized in regular prose—or perhaps the stories themselves would need to told at a symbolic level to conveniently side-step these difficulties—but in theory this could be a fun, simple piece of drama manager based shared authorship.

In short, drama managers are exciting tools that have already been used to great effect, and these metaphors can easily be leveraged toward the cause of shared authorship.

2.1.8 Player Modeling

Just as it is important for works of shared authorship to have a developed understanding of the narrative works that they are helping to create, it is important that they have an understanding of the human collaborators that they are working with. One potential source of inspiration for this developed understanding comes from the research area of player modeling.

One player model that serves as an exemplar of the field is the *PaSSAGE* system by David Thue [297]. PaSSAGE works by identifying which of several classifications best describe the player, such as how much they are a “power gamer” that wants to crush enemies and optimize their path through the system, “storytellers” that wish to discover all of the exotic locales and stories a game world has to offer, and “method actors” who wish to immerse themselves in the lore of of a game’s world and commit to behaving as one might given their character’s circumstances.

The system can adjust its classification of the player through their game play. At its simplest, the game designer can label certain actions as having a weighted membership to one or more of these classes, for example, slaying a monster might primarily be considered a power gamer action, but also slightly be within the purview of role playing. Thus, when a player slays that monster, the player model adjusts its understanding of the player accordingly (i.e., marks them as being more of a power gamer and method actor).

Now, having this player model is all well and good, but it’s what one does with it that really counts. In the case of *PaSSAGE*, this took the form of being implemented in a game that provided the player with additional opportunities to engage in the activities that the system believed that they liked. That is to say, if the player proved themselves to be a power gamer by slicing up a monster, then the system would subsequently present them a bevy of monsters for slicing delight. If the player instead had shown themselves to be a storyteller, than in lieu of monsters the game might reveal hidden pathways to satisfy the player’s wanderlust and love of discovery.

This is exciting, and in some ways is a natural extension of the high agency experience that was presented in our discussion of *Doom* in chapter 1.1.2; while *Doom* only allowed for a high agency experience with regards to having a host of monsters to fight, this experience can similarly balance a relatively small amount of material and formal affordances to yield high agency, but agency tailored to the individual tastes of the player.

However, any player model also runs the risk of gathering false positives, and developing an incorrect understanding of the player. Take a model like the *PaSSAGE* system; our player starts slaying all of the monsters in the immediate area, the system perceives the player to be a monster hunter extraordinaire, and consequently fills the world chock-full of monsters, while simultaneously decreasing the presence of other elements deemed preferable to other player types. Although this sounds like a dream come true, what if our player was never as blood thirsty as the system perceived? What if the player killed those first monsters by mistake?[11] Perhaps most tragically, what if the player detests killing and was really looking forward to all the exploring the game had to offer, so they finished the combat sequences of the game first to get them out of the way, only to find that by saving the best for last, they had inadvertently removed the best from the game?

[11]You don't believe anyone could kill a virtual creature by mistake? I beg to differ! When my dear sweet mother first started playing *World of Warcraft* [66], she was given a quest to defeat some number of wolves terrorizing an abbey. After defeating one wolf, she right-clicked on it to attempt to acquire its wolfly possessions. However, right at the moment she clicked, an innocent, pacifist deer happened to walk over the wolf's body. The game interpreted my mother's click as an act of aggression against the deer, who sadly fell to a single swing of my mother's sword. Accidentally killing a deer—even a virtual one—upset my mom tremendously. Don't let anyone tell you that accidental virtual murder does not happen.

These cautionary tales certainly do not obviate the utility or importance of player modeling; they only are meant to serve as reminders that though it is relatively easy to recognize the player's actions, it is another thing entirely to successfully interpret the intention behind them. Because of this, it is generally a wise idea to include mechanisms to "unlearn" the determinations a player model has made about the player. This is useful not only as a means of hedging one's bets in case the player model has erroneously classified the player, but also accounts for players themselves changing over time.

This change over time is perhaps most easily reflected in a specific form of player modeling known as dynamic difficult adjustment [107]. In this form of player modeling, the system determines a sense of the overall skill level of the player, and—once it has made this determination—uses it to raise or lower the difficulty of various elements of the game; typically with the aim of achieving a state of flow where the game's challenges are in line with the player's skill such that they are not too easy (and inducing boredom) nor too difficult (and inducing anxiety and frustration) [36]. As the player eventually begins to overcome challenges, it is important for the system to be able to recognize their growing skill, so that it can raise the challenge level of the remainder of the game accordingly.

Player classifications have proven to be useful in non-computational areas of game design as well. For example: the popular trading card game *Magic: The Gathering* has inspired the christening of three player archetypes, affectionately known as Timmy (or Tammy), Johnny (or Jenny), and Spike [175]. A "Spike" player is primarily interested in winning the game, and values cards and strategies that will enable them to do so efficiently and consistently. "Timmy" players are primarily interested in "having fun", playing cards that might not necessarily reliably win them the game, but that are satisfying to play, such as a large creature that—though perhaps easily removed—will deal major damage to the opponent if left unattended. A "Johnny" is interested in playing the game in such a way that their personal creativity or intelligence shines through; this could be through the construction of an unusual deck, or through finding a powerful synergy between cards not typically paired with each other. These archetypes not only enable players to self identify, but it provides a vocabulary for the game designers to use when developing future cards (e.g., when releasing a new set, they might strive to release an even amount of "Johnny", "Timmy", and "Spike" cards to satisfy as many players as possible; aiming for this goal would most certainly influence the design of the cards themselves). And, of course, there can be hybrids of the archetypes, for example a "Johnny/Spike" wants to win but to do so in a "unique" way.

All of this is to simply to say that there are myriad uses to having an understanding of the type(s) of players one is working with, both at design-time and run-time. In a context of shared authorship, the system can, over time, begin to learn the preferences of the player. This directly ties in with one of the pleasures of shared authorship discussed in chapter 1.2; the sensation that, over time, one's collaborators are getting to know them, and this deepening bond affects their working relationship with one another. In some senses, *PaSSAGE* is a work of shared authorship, in that the actions of the player influence the proceedings of the system, which in turn affects the actions of the player[12];

[12]I'm aware that this description appears overly reductive; as discussed in chapter 1.1.1 with the introduction of the listen-think-speak loop, every gameplay system has a looping property of player

the only danger is the one previously described, where the player and system run the risk of getting trapped in a vicious cycle in which the system only presents a single type of content to the player; without alternatives, the player has essentially lost their means to meaningfully engage with the system on a collaborative level. There also tends to be an inclination in player model systems—as with drama managers discussed in chapter 2.1.7—to hide them behind the scenes, thus making players unaware that their collaboration exists.

I do not believe that many player models have been used in explicit shared authorship contexts, but I believe they would be a valued addition were they to be incorporated.

And with that, I conclude my march down related work lane, at least as it pertains to research in the fields of computer science and game design. There is, however, another major aspect of my education, profession, and passion that I feel can be drawn upon for purposes of shared authorship, and also that I just love talking about in general: that of the Theatre.

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actions influencing the game world which then influences the player's possibilities for future actions. Here, when I link this experience to the pleasure of feeling understood by a collaborator, I am referring not generally to a system changing a gameworld based on player's actions, but specifically towards the system updating its underlying model of the player. The system then displays this understanding of the player through updating the game world, true, and depending on the framing of this update, the player might not be aware that this growing understanding is occurring, even when it is. Therefore, using a player model in and of itself is not sufficient grounds to say that this pleasure is present; rather it is a means to achieve the phenomenon technologically which then must be appropriately used by the experience itself to make its presence known and appreciated by the player.

2.2 Related Work: Narrative and Theatre

You might be wondering why is there a section on Theatre in this computer science dissertation? Well, it might surprise you to know, gentle reader, that prior to pursuing a PhD in computer science, I earned a graduate degree in Theatre Arts. I've been an improviser for over ten years (hopefully many more, by the time you're reading this!), and have even had a stint or two as a professional actor. The theatre is near and dear to my heart, and truth be told, it is the feeling of being a part of an ensemble, of being an important part of an important whole, that helped me to form my love of collaboration and my interest in shared authorship.

Putting on a play is a large undertaking; though every production is different, most modern day productions involve some number of actors, a director and assistant director, a stage manager, an assistant stage manager, a set designer, sound and light designers, sound and light board operators, prop masters, costume designers, and run crew. Before all of this a playwright had to write the play; though the playwright may be unavailable to be directly involved in the production, the rising position of the dramaturge [35] can help provide the research necessary to ground the work in its proper historical context. If the play is a musical, throw in some musicians, lyricists, vocal coaches, and choreographers. If the play has combat, call in a fight master. And this is just for putting on and rehearsing the play, never mind the folks responsible for booking touring venues, cleaning the theaters, ushering audience members to their seats, selling concessions, designing publicity fliers, or changing the letters on the marquis. Truly, the amount of work that goes into a theatre production is staggering, a humbling testament to what can be accomplished when many hard-working individuals commit themselves to a common cause.

I think it is fitting that I look to the theatre when forming a theory surrounding the inherently collaborative nature of shared authorship.

2.2.1 Brecht

Although there is a plethora of theatre scholarship that emerged and developed in the intervening millenia post Aristotle, for the purposes of shared authorship I hope to spend a moment focusing on the insights and philosophies of Bertolt Brecht [22], as I believe that several of his techniques that he employed in his theatre productions have direct application towards the cause of producing digital works of shared authorship.

Brecht was a German philosopher, playwright, director, and theatre theorist, whose opinion on the role of theatre differed greatly from his contemporaries. While the vast majority of theatre practitioners adhered to Aristotle's views on theatre, Brecht believed many of them to be contradictory to what the goal of the theatre should actually be. Let us take the notion of the catharsis as one example. The catharsis, as described by Aristotle, is a purging of emotion; all of the pity and fear welled up in the heart of the spectator throughout the course of the play is released at the moment of the dramatic arc's climax.

Brecht believed that this climax was detrimental to any piece of theatre hoping to make a social change; that along with their emotions, the catharsis purges spectators of their drive to improve the societal issues presented in the play they just witnessed. To foster a breed of theatre going activists, Brecht wrote and directed plays that denied the audience this catharsis; often ending abruptly without resolution of the drama's central conflict. In theory, this would make audiences leave the theatre charged with the desire to make their own happy ending in the actual world.

Another of Brecht's beliefs was that audiences would forget themselves and the world around them in typical theatre productions. Through a process of identification with the central protagonist, the audience would forget their own lives and thoughts for the duration of the play and instead adopt those of the hero. Brecht believed this act of suturing one's self into the action of the performance limited one's ability to think critically about the societal messages embedded in the play and its performance. To combat this, Brecht wrote plays that lacked a central protagonist, either making use of an ensemble cast, or protagonists with dual personalities, such as in *The Good Person of Szechwan* [23].

This prevention of identification could be considered one application of Brecht's most well known tactic: the *Verfremdungseffekt*, commonly known in english as the distancing effect or alienation effect. In Brecht's theatre productions, he would constantly attempt to find ways to remind the audience that they were in a theatre, watching actors perform roles that were not themselves. Brecht's goal was to push the audience outside of the world of the play, such that they might retain their mental faculties and intelligently parse the production's content, and be moved by it to the point of enacting change in their own lives. Some techniques at achieving this effect include exposing elements of the theatre typically hidden, such as the sources of the light beaming onto the stage, presenting title cards between scenes, having characters break the fourth wall to address the audience directly, and juxtaposing beauty and horror, such as playing classical music during a scene featuring rape.

Another component of the alienation effect that I did not fully appreciate until I was in a production with Brechtian elements myself[13] is the fact that the ideal Brechtian actor does not attempt to lose themselves in a role, in contrast to both Strasburg's method [281] (though both require a comfort and understanding to be one's self), and Stanislavky's system [276]. In these two systems, the actor finds a character—for instance, through drawing upon personal experiences that hearken to what the character must experience emotionally—and for the duration of the performance loses themselves in this character (and in the case of Strasburg's method, sometimes for the entirety of the production). One of the greatest compliments such an actor can receive is that of being a transformational performer; eliminating all traces of the actor's self in the performance, to make complete space for the character they are portraying to shine through. This is not the goal of the Brechtian actor.

The Brechtian actor strives to portray their character while simultaneously retaining their own selves. They speak their lines not with the intention to convince audiences that they are someone else; but rather to at once communicate the narrative of the

[13]Also, just to express a brush with celebrity, the modern day Brechts are family friends with the Schumanns; Peter Schumann founded and currently runs the Bread and Puppet Theatre Company. I went to visit a friend there in the summer of 2015, and ended up performing with them in a few shows, including going on tour and performing at the National Puppetry Festival at the University of Connecticut. It gave me my first personal experience in performing in a piece with Brechtian elements for actual audiences, and remains a very fond memory for me.

play (as the character) and provide critical analysis of the character's choices and world outlook (as themselves). This partitioning is challenging to master (Brecht lamented the difficulty in finding actors who could successfully pull it off) and can be very offputting for audiences accustomed to "traditional acting." This jarring nature is, of course, all part of the intended alienation effect.

One very important facet of this alienation effect, however, is that—even though thus far I have mainly described ways in which the audience is pushed away from the illusion of the theatre—it is equally important Brechtian works have moments that draw audiences in, as well. Most typically contain an engaging narrative with fascinating characters (even if they are not written to be identified with or lost in), as well as music and song. Brecht does not abandon the conventions of traditional theatre, so much as he situates them in new contexts wherein they are better exposed. This exposure, though jarring to a newcomer, can ultimately lead to a greater depth of understanding of the theater itself, and—as previously discussed—has the potential to inspire people to effect positive change in their lives and their society upon leaving the theatre.

Broadly speaking, I think that exposing the inner workings of a "thing"—be it theatre, a machine, a computer game—is a powerful tool to educate about how that "thing" is made. One such example of applying the Brecthian philosophy to a game context is in the description of the game *Bestial Acts* by Greg Costikyan, described in the appendix of *Second Person* [95]. The description of the game blurs the boundary between traditional game-playing and role-playing and actual theatrical production. It goes into great detail describing the overall plot structure, generally pertaining to starving survivors debating whether or not it is ethical to resort to cannibalism. The description of the rules is split into multiple parts, as the mode of the game changes as play continues. Then, finally, when the rulebook reaches the final part, the game designer appears to quit mid-explanation, bemoaning the game's lack of commercial viability, despairing at the futility of completing its design.

Although at first I was quite taken aback, I realized—a bit embarrassingly later than I care to admit—that the description of the game's final act was the most Brechtian element its rules contained. Brecht's theatre is not about providing solutions; it is about galvanizing an audience to figure solutions out for themselves. Here, players create not only their own ending, but their own rules for finding it; moreover they do so not because the rules explicitly told them to, but in the face of the rules themselves despairing at concerns not directly connected to the game such as marketability. A Brechtian game with a complete rule set could very well lead to the Aristotelian equivalent of catharsis by merely reading the rules, giving potential players the false sense of understanding the game without having gone through the critical thought process of playing it themselves. Here, players are offered no such out; they are either to finish it to understand it, or to be forever left wondering.

I bring all of this up to drive home two points. The first is that Brechtian philosophies can be applied to—and indeed have a place in—game design. The second is hopefully just an elucidation of something that we've seen many times throughout this dissertation already: exposing the mechanisms that make something work can be an intended part of the experience that radically shift the experience into something entirely different, something that provides a deeper appreciation for the original form.

When I examined both drama managers and player models in 2.1.7 and 2.1.8 respectively, we saw how the typical modus operandi is to hide the fact that anything is transpiring behind the scenes. Part of that discussion revealed that there are good reasons for doing so, but most of the reasons circled around trying to create games in which the primary goal is to convince the player that they possess a high degree of autonomy in the unfolding of the game's events; to reveal that they had an invisible helper behind the scenes adjusting the very fabric of the game's reality itself exposes their perceived autonomy as illusion. That is perhaps an overly harsh analysis to use as a broad stroke for all games, and indeed, many games are attempting to use the aforementioned developing technologies to honestly, genuinely provide players with greater senses of agency. However, though these exceptions certainly exist, the majority of games out there adhere to the tropes I've already covered again and again: players are merely selecting, customizing, tailoring an existing narrative (or one of a handful of narratives) to their personal tastes.

By exposing the inner workings of games, by applying some of the magic of the alienation effect to our works, designers have the capacity to create radically new pieces of playable media. By exposing the rules of the system, the considerations of the entities tirelessly working behind the scenes no longer hold the danger of breaking the player's immersion, but rather *promise* to do so. Total immersion into the world of the play was the enemy of Brecht's theatre. Although such strong language does not seem appropriate, at least at this time, to apply to shared authorship, I do think that pieces of shared authorship require an analysis of form that many pieces of traditional interactive narrative do not ask of their players, as their forms are relatively static. Thus, though I can easily imagine a framing of shared authorship in which one is utterly immersed in the action (for a non digital example of this, please see section 2.2.3, which details live improvisational performance), it must not be a solitary immersion. Losing one's self to the moment is acceptable, but losing one's collaborator is death, for it is through the reflection of the collaborator that one can discover one's self.

The above description is, admittedly, a little intense; fueled by personal experiences on stage. The initial forays into shared authorship that this dissertation will describe will, perhaps, not elicit fervor to the intensity alluded to above. However, though present playable experiences may not be achieving it yet, that does not diminish the importance of remembering the powerful emotional reaches the non-digital inspirations that motivate this work enable us to access. And, as will be seen later on, some of the work described has indeed led players to have quiet moments of self-reflection through working with digital collaborators.

The major takeaway is that, though Brechtian theatre has a reputation for being disorienting, at the end of the day it aimed to be art replete with both entertainment and cultural value. I think that exposing underlying systems of a game (such as, say, drama managers and player models), has the potential to deepen the player's appreciation of the game (directly combating the dangers of opaque-system intelligence as described by Wardrip-Fruin's Tale-Spin effect, see section 2.1.3) and enable hithertofore under-explored modes of interaction.

2.2.2 Peter Brook's Empty Space

Another theatre theoretician I wish to mention is Peter Brook, whose collected theories in *The Empty Space* [25] marked one of the first books about theatre theory I ever read upon becoming a University undergraduate. Though the terms and theories he introduces were originally meant to describe an art form that has existed for millenia, I believe that his insights can be fruitfully applied to the relatively nascent art form of digital games. In so doing, it provides us with another lens to further disambiguate shared authorship from interactive narrative pieces that have come before it [14].

Brook provides four labels to categorize the theatre landscape: deadly, holy, rough, immediate. For now, I would like to focus on two: the deadly theatre, and the rough theatre.

The deadly theatre is, in some senses, the same kind of theatre that Brecht's work was a direct response to; theatre that lacks substance. The name, deadly theatre, comes from a fear that audiences watching this type of theatre will begin to assume that this is all theatre is capable of. They will grow bored with trite plots, recycled forms, and predictable endings. Deadly theatre is theatre that is deadly to the medium of theatre itself. Although I fully expect some readers to quibble with this argument, I feel that many AAA video game titles today run the danger of being considered "deadly games."

As discussed in chapter 1, many modern story-games today are using technologies no more sophisticated than the completely non-procedural Choose Your Own Adventure

[14] I must confess, it also only seems fitting that, in this, my (supposed) final act as a student, I close the circle by paying tribute to that which first set me off upon this path.

novel to tell their tales. Up to this point, audiences have been kept engaged by increasing the degree and depth of spectacle present; higher polygon-count character models, mo-cap technology to capture high fidelity actor movement for cut-scenes, hiring many writers to author more content than ever before. This is, however, not sustainable for all but the largest studios, that have the budget and resources to take this brute force approach to "solving" the problem. Though this analogy is a bit unflattering to the player base, I feel that this is not so much "curing" the desire for novel experiences, but rather ever-so-slowly building up a tolerance for existing ones. As diseases build up tolerances to medicine, eventually they cross a threshold through which modern science is unable to cure them. I fear that this is the path AAA games production is going on; slowly but surely raising expectations for game content that eventually they themselves will be unable to satisfy.

This collapse, if it were to happen, is probably still some time off, as the games industry—at the time of this writing—continues to grow in size and profits [172]. But that said, cracks in the facade can perhaps be seen through the growing surge of support for independent game developers in recent years. In fact, indie growth has been so large that some even believe that the indie game industry is starting to collapse upon itself, though this belief is not held by everyone [313]. Regardless, if the AAA game industry has parallels with Brook's "Deadly Theatre", then the indie game scene finds analog with Brook's "Rough Theatre".

Rough theatre is quick, dirty, unpolished[15]. Unlike Brecht's theatre, as discussed in

[15]Allow me to do some immediate backpedaling and assure you, gentle reader, that I recognize that many indie games are *incredibly* polished pieces. More often than not though, simply due to lack of

2.2.1, that might expose elements of the theatre to drive home an artistic point, Brook's rough theatre might leave theatrical elements out in the open simply because the players do not have the means to hide them. A personal example from my teenage years: during night performances on a poorly lit outdoor amphitheater, me and my fellow Interns-In-Training would drive our cars up to the stage, our performances bathed in the glow of car headlights. This solution was, perhaps, borne more from us being the bearers of freshly printed driver's licenses aching for excuses to use our new found automobile affordances than anything else. All the same, it is an example of making do to produce art with limited resources, and the creative solutions that such circumstances inspire.

The typical improv performance (see 2.2.3) could also be considered one of rough theatre. Though there are certainly improv shows that are exceptions, most are unfettered with scripts, costumes, or blocking, relying instead on approximate forms. Rough theatre does not equate to low quality, so much as it refers to low production value. The charm of getting something, anything, up and running is something to be admired, and it is this aesthetic which I believe the early days of shared authorship are likely to adhere to.

In some senses, I look forward to the day when developers start to create "deadly" pieces of shared authorship; when the aesthetic conventions of the medium become so rote that they can be "enhanced" by simply throwing more person-hours towards them. For now, though, the form itself—its mechanisms, principles, and values—are still being identified. Because of this, the forays described herein will most definitely be rough;

resources, they lack the corporate sheen of their AAA counterparts.

there may be mis-steps. There may be missed opportunities; or misleadingly alluring features. This period of rummaging in the dark is one way through which I might discover the light to illuminate the form.

2.2.3 Improv

I have come, at last, to a subject near and dear to my heart: one on improvisational performance. As I mentioned in section 1.2.3, I have ample experience in improvisational theatre, and I steadfastly believe that works of shared authorship can borrow from the collected wisdom of its most erstwhile practitioners and scholars in order to create the conditions to facilitate and encourage the many contradictions of the craft—vulnerability and comfort, risk and security, camaraderie and individual genius—all qualities that I perceive to be important in creating art in general, and ideally should be present in engaging with a work of shared authorship. In this section, I'll be covering a variety of improv games, forms, and philosophies that highlight the above, as well as providing general context to the craft as a whole.

2.2.3.1 My Improv Background

Improv, if it is not already clear, is something that I enjoy doing very much. Though I would like to thank all my acting teachers over the years who exposed me to improv games as theatre exercises (who only later would I learn were probably following the applications of improv as rehearsal techniques outlined by Viola Spolin [272]), it was not until high-school that I recognized that improv shows could garner audiences in-and-of-themselves when I went to my first Comedy Sportz show. It wasn't until college that I was in my first all improvised show in front of an audience (*PinkE*, a student "written" piece that essentially boiled down to improvised speech and debate), and it was not until I was a Theatre Arts graduate student, when I auditioned and made it on to two collegiate improv teams, that I got my first taste of what it felt like to regularly perform with a dedicated improv troupe. And it wasn't until *after that* when I moved to Los Angeles and met the illustrious J.D. Walsh at the Ultimate Improv theatre in beautiful Westwood, California (now The Improv Space, at the time of writing) where I actually felt like I began to understand what improv is, and more importantly, what it could be. I say this not to besmirch my many improv teachers prior to that point (Kristen Walter, Holly Cornelison, Jordan Dobbs Rosa, Tim Shannon, Em Gift, Dan Mack, to name a few), but rather to illustrate that, speaking as someone who immersed himself in theatre from a young age, it still took me a shockingly long time to fully grok the potential of the art form. I shall do my best to consolidate my years of education and practice on the subject for the benefit of the reader, but I acknowledge it might well be a task beyond my measure.

2.2.3.2 An Improv Primer: On Following Rules and Being Funny

Improv has, for a long time, probably been most easily recognized in the media through the television program *Whose Line is it Anyway?* Styled as a game show where "the games are made up and the points don't matter," the improvisers amazed audiences with completely unscripted scene work. The facility with which they performed, the casual ease with which they slipped in and out of a multitude of characters, impressed me so much as a youth that I at first firmly believed that it couldn't possibly actually be improv and must have been rehearsed ahead of time.[16] The skill of these performers was mesmerizing, and they likely raised great awareness of the very existence of improvisational performance on a national scale.

However, as I've become exposed to more forms of improv, I've grown concerned that instead of providing an introduction to the art form, *Whose Line* might have left audiences mistakenly believing that *Whose Line* represents the pinnacle of the craft. The improv performed on the show comes from the ComedySportz tradition, which itself was an offshoot of Theatresports, developed by the inestimable Keith Johnstone. While Theatresports valued narrative, scene building, and developing character relationships (staged in a faux-competitive setting), ComedySportz—as perhaps evidenced by the substitution of the letter "s" for a "z"—shows tend to be higher energy with shorter scenes and, consequently, sometimes struggle with creating genuine situations on stage.

I want to reiterate again that the improvisers on *Whose Line* were immensely talented, and indeed, being on my high school's ComedySportz team was one of my first exposures to the craft; and even over a decade and a half later, I can still recall specific scenes and moments from a professional ComedySportz show I watched as part of that training. Anything I say that makes me sound like I think poorly of these forms is a mistake. It is a matter of tastes changing over time, as one is exposed to more offerings.

All of this is to say that *Whose Line* instilled within me—and many others who

[16] I later learned that what was seen on TV were essentially "best of clips" of longer live performances, but their talent remains unassailable!

only have a passing familiarity with improv—the notion that improv is fundamentally about going on stage and being funny, that the goal of improv is to think of clever turns of phrase, fill scenes with puns, gags, and jokes, and—above all else—make the audience laugh. This interpretation was formed by the type of improv I had been exposed to in my life up to that point: very funny people being placed in situations with silly premises ("a weatherman who describes meteorological phenomenon as if he was a sports announcer!", "two long lost friends who can only speak in questions!", "a chef cooking with arms that belong to another person standing behind him!"). Does it take a lot of artistry to be able to conduct a scene where everything is phrased as a question? Yes, assuredly. Does two actors embodying a single person require a great deal of teamwork? Undoubtedly! It was without question the profound depth of skill latent in these performances that reinforced within me that this *was* what the art form was. But as it turned out, as long as I held onto this conception, I was severely limiting myself and my ability to progress as an improvisational performer.

Because as long as I held on to this belief, I found myself struggling desperately on stage; I rarely knew what to do or what to say. My contributions felt middling at best; though they often elicited laughter from the audience, it felt hollow. This was made all the more frustrating by the fact that—I felt—I had a strong grasp of the basic tenets of the craft, drilled into all fledgling improvisers. Perhaps the most well known of these is the notion of saying "yes, and" to offers from one's scene partners. An offer, in the improv context, can be anything—verbal or non-verbal—that establishes something about the world of the scene. A sentence. A word. A glance. A breath. To say "yes" is to accept their offer, acknowledge it to be true, to honor one's scene partner's contributions. To say "and" is to return their contribution with an offer of one's own. Through this continual back and forth, eventually an entire world is created.

Beginner improvisers commonly hold the misconception that in order to be a good scene partner, one must literally use the words "yes" and "and." This is not the case! The idea behind this "rule"[17] is to react truthfully to what one's scene partner is establishing. Sometimes, sure this does mean literally saying "yes" but often reacting truthfully involves saying the word "no."

An excellent example of this is detailed in *Improvisation at the Speed of Life* [106]. If one's scene partner casually says something along the lines of "Hey, there's a blazing fire over there, go jump into it," this would be a situation where literally saying yes and doing what your scene partner asked of you is a denial of the reality of the scene. Jumping in fires is dangerous; to do so could easily lead to one's death. It would take an extremely particular relationship between two people for one to be able to command the other to jump in a fire, and the other to acquiesce. It would be the type of relationship formed over the course of many scenes; audiences weep at Lennie's death at the hands of George in *Of Mice and Men* [277] because the reader/theatre-goer had an entire narrative to learn of the unique nature of their relationship. Imagine, for a moment, that two real people—we're no longer talking about improv here—happened to be by a

[17]The notion of calling anything in improv a "rule" is suspect since, as Mick Napier says, much of the best improv probably breaks them anyway [178]. Rather than "rules," I prefer to think of them as guidelines that have been determined through experience to increase the probability of a scene being successful. There are, without question, amazing scenes that have transpired that break every improv "rule" ever conceived, just as there are lousy improv scenes that follow them to the letter.

fire; maybe they're at the beach at a bonfire, and one asks the other to jump in it. It is clear that—in the context of real life—being asked to jump into a fire is essentially the same as being asked to kill one's self. Most people, I dare say, would react to that sentiment with shock or disgust. They'll be hurt that their friend would suggest something so cruel. They'd roll their eyes that their friend would suggest something so dumb. They'd be confused that their friend would suggest something so bewildering. Maybe they'd laugh it off, knowing their friend was attempting to make a joke. In almost every context, they would not throw away their lives by flinging themselves into the flames.

Why should it be any different in an improv show?

Here, saying "yes" is to shout "no!" To do otherwise is to deny the reality of the fire (it's hot and dangerous) and its effect on human flesh (melty and fatal). Even if one honors the fire by jumping into it and performing a screaming, agonizing death, it is denying the reality that *that's not what normal people do.* Maybe, you reason, you aren't playing a *normal* person. Maybe you are playing someone that has been brainwashed by your scene partner, and must carry out their bidding. Maybe your character has been considering suicide, and this off-hand remark from a so-called friend is what finally pushes you to off yourself. There are countless reasons why one might potentially justify the action, but you do not get those for free. It's only through slowly, gradually revealing information, adding information to the scene piece by piece that improvisers *earn* those unique contexts. And, to again quote Napier, "context is everything." If a melodramatic villain of a scene commands the hero to jump in the fire; the audience might raise their eyebrows at the likely ineffectiveness of their plea, but it more acceptably adheres to the type of relationship one would expect between a hero and a villain. Even in this context—perhaps especially in this context—one would still expect the hero to say "no" though.

2.2.3.3 Fewer Rules, Deeper Relationships

All of that is simply to say that though I had a clear understanding of these "rules" I still had a hard time actually advancing scenes; and I feel that it is because I did not fully understand or appreciate the importance of being present with one's scene partner, and making the scene about one's scene partner. Or rather, I "knew" the rules pertaining to "make your scene partner look like a star," and understanding that at the top of the scene, you have absolutely nothing but your fellow scene partner on stage with you, so you have no choice but to clutch on to them for dear life. But I realize, in retrospect, that I did not understand how to make them a star; how to make the scene about the other. Similarly to how saying "yes, and" might actually involve saying "no," what I failed to comprehend for so long was making a scene about your scene partner might involve a lot of sentences that begin with the word "I." The secret to establishing a clear, dynamic relationship, I eventually learned, was to make it clear to yourself, your partner, and the audience, *how you felt about your partner.*

As a performer first learning this trick, the difference was night and day. It was such a blessing no longer worrying about being clever, or being funny, or even making the audience happy. The only thing to "worry" about was making sure that my scene partner understood how I felt about them; a tangible directive I had control over. Though I recognize it might seem trite reading it in this context, saying something as simple as "I love you" to one's scene partner was an *immensely* powerful move. Though it still leaves much to be filled in regarding the nature of the relationship (it could be parent-child, spouses, siblings, good friends, even a first date; does the other person love them back?), it immediately grounds the scene with an emotional dynamic (the *heat*, see below), providing a firm foundation for revealing all of the above information and more.

All of this is to say that even in the intangible morass of improv, there are certain structural components, almost blueprints of sorts, that can be relied upon to yield a (more often than not) successful scene. I am not necessarily saying that works of shared authorship will be able to leverage these same blueprints[18], but I feel that similar practices will ultimately be discovered that will help guide the interaction process with works of shared authorship; these discoveries will in turn aid designers in the development of future pieces.

Relationship is the R in the acronym CROW, often used by improvisers—and actors in general—as a mnemonic device to recall four of the most important qualities to establish in any scene: Character, Relationship, Objective, and "Where" (referring to the scene's setting). Most actors are trained that Objective (or, in other words, what a character wants) is the most important quality to a performance. Directors are taught to help actors discover their wants [10], actors are taught that their objectives are the driving

[18]Though, truth be told, if there existed a system in which the entire purpose was for both the player and system to express how they each felt about the other, I would find that to be pretty incredible.

forces of scenes, and many acting classes center around exploring different tactics to achieve a specific objective [166]. Though by this point it might only be said in jest or satire, when an actor asks "what's my motivation?" they are referring to their objective.

With all that said, I've still personally found that starting with a firm relationship is the secret to success in an improv scene, and to trust that everything else will be discovered over time. As long as one isn't afraid to tell their scene partner how they feel about them, they'll be fine.

Learning to talk about how my character feels about their scene partner went a long way towards helping me perform more genuine improv. Another insight from Jagodowski's and Pasquisi's *Improv at the Speed of Life* [106] succinctly summarizes the vast space of potential improv relationships into two measures: the *heat* and *weight* of a scene. The heat refers to the emotional intensity and intimacy between the two improvisers. This is truly what the relationship is; many novice improvisers will mistakenly think of the "title" of the relationship (siblings, parent-child, doctor-patient, etc.) as all they need to know. Note that heat is independent of title, a married couple can be emotionally distant or deeply in love; a barista and patron be strangers or bosom friends. The weight of a scene refers to its context, or "what is already in the room;" the more difficult, complicated, or frightening the context, the greater the weight. For example, a high heat, high weight scene might entail a character confronting their lover about an addiction; a high heat, low weight scene might involve those same characters going grocery shopping. These two concepts, in their simplicity, are capable of capturing the tenor of a wide breadth of improv scenes. Moreover, they offer an alluring mechanism towards operationalizing improvisational performance as they seem, at least, to be somewhat measurable phenomena of a medium that has traditionally resisted such metrics.

2.2.3.4 The Four Degrees of Reality and The Panoptic Form of The Form

Another major realization that pushed me as a performer was learning that improv did not have to be fictional; that the matters discussed in an improv performance could blur lines between character work and one's actual self. Let me explain with an example.

The term "form" in improv is an overloaded one. Broadly speaking, there is long-form and short-form. Short-form consists of games such as the reader might be familiar with from *Whose Line is it Anyway?*, games that typically last no longer than a few minutes, and that consist of scene work with artificial rules or premises placed upon them (such as assigning the improvisers to perform very specific characters, or for their scenes to be set in very specific circumstances). Long-form improv can last anywhere between twenty minutes to a full length play; while the varying unit in short-form is the "game," the different types of long-form are known as forms. Thus, there are many forms of long-form improv. *The Harold*, developed by improv legend Del Close, follows a pattern of three scenes followed by an ensemble based group game, repeated a total of three times. *The Armando* involves a monologist (often a special guest not affiliated with the team, or someone from the audience) telling stories from their own lives, which will inspire the troupe to perform a variety of scenes, when in turn inspires further monologues. One form, which bewildered me upon first learning it but I have now come to love dearly is simply, if not confusingly, named *The Form.* Though I confess to not knowing the true origins of the Form, it seems likely to have earned its name by being a panoptic incarnation of the craft, with all flavors of improv—the short and the long, the silly and the sincere—falling under its purview. I describe the Form here because, like the holodeck has been an imagined ideal for immersive interactive storytelling, the fluidity and dynamism the Form affords its practitioners makes it an ideal for future works of shared authorship. It also introduces the notion of there being four different degrees of reality which I find to be useful to describe both improv and computational experiences alike.

The Form centers around the notion that there are four different degrees of reality. Any given scene will primarily exists in one of the four degrees, but any given performance of The Form will continuously and fluidly shift from reality to reality, keeping audiences and improvisers guessing as to which degree will be visited next (and, indeed, which is presently transpiring). The four degrees of reality become progressively more surreal. The first degree is the least surreal, as it is, literally, actual reality. The improvisers make no pains to hide that they are themselves on stage; they are not playing characters, they are "playing" themselves, they aren't fabricating a new physical environment, they are free to acknowledge the performance venue and the audience. Scenes in this reality often take the form of heart-to-hearts, or conversations between two improvisers about personal anecdotes, shared histories or—as discussed earlier—about how they feel about each other.

The second degree is similar to the first; it is mostly reality, with a small fiction interwoven into the scene. That is to say, the two improvisers are mostly themselves, their life experiences remain mostly true, but at some point some narrative license is taken and the improvisers begin to portray a version of themselves that differs ever so slightly from their true selves. This can be as simple as a small fib (e.g., claiming to “love mustard” when one actually detests it) to transparent lies (e.g., “I’m in the witness protection program for killing someone”). Although the latter might initially seem the more interesting of the two extremes, when the fiction is larger than what one can reasonably be expected to swallow, it becomes much more difficult for audiences to become invested in the scene (and the scenes themselves tend to quickly shift into the third degree, see below). Conversely, and perhaps surprisingly, by interweaving small, seemingly inconsequential fictions into the scene, it can have potentially profound effects on how an improviser approaches the scene by providing them the gift to shift their perspective, to, for example, ask themselves questions such as “what if there was a version of myself that loved mustard?” Answering questions such as this, exploring a “character” that is still mostly themselves but with this slight deviation, can sometimes have a butterfly effect on the character. This small shift in thinking suddenly opens entire new avenues of thought.

Of course, this shift in perception can be done at any degree of reality, but by starting with the most well defined character an improviser is ever likely to portray in their lives (i.e., themselves), many find it easier to then make tweaks and adjustments from there to discover their character. This is sometimes known as wearing a character as a thin veil over one’s self. The performer is still mostly themselves, but their world view is influenced by the assumed context of their role. The best second degree realities, in my experience, are the ones that blur the line between first and second so finely that even the improvisers themselves, after the scene, must confer with each other about the exact nature of the reality they just visited together.

Jumping back to my description of the different realities, the third reality is perhaps the most straight-forward, as it is simply what is often considered to be the "traditional" improv scene. All of the improvisers on stage adopt the role of a character that is separate from themselves. They're firefighters holding a chili cook-off. They're doctors relaxing after work at a local bar. They're a mother and son getting ready for the first day of a new school year. Though the characters might, as just described, be thin veils, the improvisers are shedding their actual selves and their context to transport the audience to a fabricated situation.

The fourth and final degree is simply this: a game or art. A game might refer to a literal improv game, along the lines of the pieces of short-form described above, it might be a game outside of the context of improv (such as hide-and-seek or contact), it might refer to the game of a scene, a term coined by the Upright Citizen's Brigade school of improv [308]. It might refer to a game that has never been played before, the rules being developed on the spot. The notion of art is similarly intentionally ambiguous. It would be doing a disservice to this reality to provide examples, as part of the power of this degree comes from whatever unique interpretation the performing troupe decides to apply to it. I have both been a part of several improv troupes that have put on "Form" shows, and have taught several workshops where improvisers who have never worked with each other prior to the workshop are asked to perform The Form at the end of a festival, and every group has put an entirely unique spin on what it this reality means for them. Perhaps I am borrowing a page from that Brechtian rule-set I described earlier; I intentionally refuse to provide examples, in hopes that you might be so moved to attempt The Form one day yourself, gentle reader, and discover your own unique blend of fourth degree reality.

Speaking of Brecht, the entire form is somewhat akin to the Brechtian notion of having the performer and the character be themselves simultaneously. Though the two modes aren't typically being done simultaneously, it is still an opportunity for a character—and the actor representing that character—to share the stage, both influencing the direction of the scene.[19]

I've mentioned that in a performance of The Form, the improvisers will seamlessly shift between these realities from scene to scene, and occasionally within a scene itself. This transitioning between the realities speaks to one of The Form's greatest secrets: as the clear demarcations of the different realities of *The Form* are of no great importance,

[19]To drive the point home, and to share a personal anecdote that is a fond memory for me, let me describe to you a relevant scene that dabbled in every reality and involved actors simultaneously performing and commenting on one's own performance. The scene in question entailed me regaling the audience with a story of going to see a musical with someone I was smitten with, and my bumbling attempts to "smoothly" divine if she reciprocated my feelings. While telling this story, two of my teammates joined me on stage and pantomimed my narration; assuming the roles of myself and my might-be-date. Here, my narration is first degree reality, but the performance of it by my teammates was a concurrent 3rd degree reality. When the story reached its conclusion and it became obvious that my would-be relationship remained in ambiguity, the performer who was playing me left his scene and—in a move which transitioned the whole experience to the fourth degree—entered my reality. I then had a conversation with "past Ben" assuring him that in the end he meets someone really special; he's just a late bloomer. This is not exactly the same, as "past Ben" and "present Ben" were performed by two separate actors, and the "character" in question was the actor's own self (as opposed to a single actor providing commentary on a character separate from themselves), but hopefully this is illustrative of the fluid nature of the Form's realities, if nothing else.

The Form itself is one of the most liberating platforms on which to perform improv. If short-form, as previously described, has strict rules to adhere to in any given game, The Form allows both aspects of heavily rule-based performance (such as a fourth degree game) to peacefully co-exist with structure-less, free-form conversation between two improvisers with no pretense for character in the same show. In other words, The Form is actually formless; it's ghostly structure just enough to provide improvisers with permission to do whatever they wish, secure in the knowledge that they cannot fail.

This is not to say that every performance of The Form is a rousing success. Many improvisers—both novice and veteran alike—struggle with the lack of structure. It depends tremendously on a team clicking together; and thus ties in so perfectly with my love of pieces of shared authorship. Because it is so different from what audiences are used to, differing greatly from both traditional theatre and traditional improvisational performance, the performer must not lose courage when they are not met with the traditional cheers and laughter they might be accustomed to. For many, it is a terrifying prospect. But when successfully executed, it is the closest I have ever personally felt to being synchronized with an improv team. And this sensation of team-work, of not being afraid to be personal and vulnerable, to imbue the work with one's very self, and to recognize that all of one's fellow performers are doing the exact same thing, is tremendously inspiring for me. Attempting to capture this sensation and provide it for others is one of my personal driving motivating forces for developing works of shared authorship.

That is to say, if one could develop a piece of shared authorship in which the algorithm with which the player is collaborating is capable of "revealing" themselves, in the same sense that a human improviser might allow their true selves to be known during a first degree reality scene, then that would go a long way towards achieving the pleasure of shared authorship in which one begins to understand the artistic underpinnings of one's collaborator. To liken it to a technology that I have already discussed, let us imagine a drama manager. It is difficult to ascribe a Form-esque reality to a drama manager's typical mode of interaction, since it is perhaps fairer to liken the drama manager to a light-board operator than one's fellow improvisers—what they shine lights on greatly influences the audience's (and improviser's) perception of the show, and their lighting choices will almost certainly be influenced by the content of the show up to that point (thus, the light board operator is in turn playing off of the choices of the improviser). Still, by virtue of the fact that one is "in the trenches" on the stage, and the other has a more panoramic awareness of the show as a whole, it is difficult to use vocabulary typically reserved for two improvisers. Still, since a third degree reality refers to all parties involved developing a purely fabricated experience, I feel it is appropriate for the typical player-drama manager relationship to be considered a third degree reality, as both parties are contributing to determining the elements of the playthrough.

Imagine, then, a shift to a first degree reality, in which the player is able to interrogate the drama manager. Not only does this expose the very existence of the drama manager (which, as was already covered, is atypical in drama managed experiences), but it gives the player the opportunity to better understand how the drama manager makes its decisions. It is possible that this interrogation might not be as naturally gripping as first degree reality scenes between humans; human based first degree reality scenes frequently talk about touching, personal anecdotes, or people share vulnerable stories about their pasts. It is difficult to imagine what an algorithm could possibly reveal that would make it feel vulnerable—not the least of which being the difficulty in imagining an algorithm feeling anything whatsoever—but an ersatz representation could easily be conceptualized.

The drama manager could make decisions based on an imagined history of it drama managing other players, and it recalling which games went well and which went poorly; by providing the player with affordances to either corroborate or refute these beliefs, the player could potentially reinforce the drama manager's conceptions of good behavior, or—perhaps by the player revealing that the drama manager's "favorite game" was in truth detested by its players, that they only feigned delight to spare its feelings—it could completely disrupt the drama manager's conception of quality, while simultaneously placing it in a "vulnerable" or "ashamed" state in which it becomes more timid to suggest changes (as unfortunately can sometimes be the case in first degree reality scenes between humans, wherein a scene partner does not responsibly or tactfully engage with a scene partner's vulnerability). Such a system would provide players with ultimately even more agency over the overall shape of the experience, but would also enable their collaborator—so often rendered invisible—to be made known. Of course, in order to make this a reality, many of these notions such as "vulnerability" and "shame" would have to actually be made manifest. But as we'll see in chapter 4, technologies towards giving digital agents the ability to reason over societal and cultural norms, which could perhaps lead to certain emotional states, are actively being developed.

2.2.3.5 Improv and Narrative

I've spent a good chunk of time talking about improv in general, and I've talked about how some of its ideals could be applied to the notion of a collaborator, but I've yet to explore how it relates specifically to narrative. It just so happens that there seem to be some conflicting opinions about the place or role of narrative in improvisational performance.

The general consensus among most practitioners of the craft is that in order to successfully engage in improv, one must be living in the moment, and—many will say—to not think. To cut off one's head and fly by heart and instinct. This does raise an interesting point about the purpose or place of narrative in improvisational performance, because if one is not thinking, then it is difficult to ensure a good story structure. Any given moment of a scene will—ideally—logically follow from the previous moment; the platform built through the collected offers should all feel narratively consistent. However, narratively consistent and good story structure are two very different concepts. If improvisers are anticipating narrative arcs, it means that they are entering the stage with agendas, which typically means that some small part of them (or, indeed some large part of them) will try to coerce a scene in a particular direction. Modern day improv wisdom teaches not to force the direction of the scene, but rather to be carried along it; the scene is the river; the scene is a spirit, and the improvisers are merely the vessel through which it is made manifest; the best thing an improviser can do is get out of the way.

And yet, though this is one particular ideal to strive for, it is not the only one; there are schools of thought that acknowledge that the pursuit of narrative can be an effective means of structuring an improv show. Sometimes this is baked into the very form itself: one form, the "Deconstruction", begins with the "final scene" of a thematic montage. Once the scene concludes, the ideas and themes present in the opening scene are explored through a number of scenes featuring different contexts. The form ends with a return to the characters of the first scene, with the audience—and the players—better equipped to understand their context thanks to gaining the perspective of the preceding scenes. The shortform game "Dimestore Novel" involves an improviser narrating a story, while improvisers embody the roles of the narrative's characters. Some forms are as simple as trying to create a complete movie, replete with the character conventions, genre tropes, and narrative arcs of a particular styling (e.g., an animated children's film, or a teen drama).

Narrative is also one of the powerful ways in which fledgling improvisers first learn the structure of scenes, and the sequencing of multiple scenes together. Scenes are encouraged to begin in medias res, in the middle of the action, hinting at backstories and existing relationships for the characters on stage. There's a tendency for novice improvisers to begin scenes in a state of conflict, primarily because that gives them an easy thing to talk about; it's relatively simple, and requires only a modicum of vulnerability, to get in a fake argument with someone. However, starting in a place of positivity is almost always better, as it afford the audience an opportunity to recognize what's at stake, what is in danger of being lost.[20] If a scene is ever in danger of "running out of a gas," having one improviser provide a strong, emotional reveal, and their partner react truthfully to it, by allowing themselves to be affected, is a surefire way to infuse the scene with energy.

Keith Johnstone [109] has a famous experiment in which he recognizes that humans are narrative beings by nature, and yet when placed on stage and asked to tell a story—any story—they'll seize up. Clam up. Shake their head, mumble they don't know any, claim that they can't. Johnstone, then, to bring ease to the would-be storytellers, would relieve them of their raconteur responsibilities, and inform them that instead *he* was thinking of a story, and they merely had to guess what it was. The improviser would ask questions (e.g., "is it about a dog? An ant? A spaceship?"), and Johnstone would respond with either a no or a yes. When he said yes, the improviser would know that they were on the right track, and would dig deeper along that line of thought, until eventually Johnstone would happily exclaim that they had successfully sussed out the tale.

Only here's the thing: Johnstone never had a story in mind in the first place. His "no" and "yes" responses were not beholden to the improviser successfully guessing the narrative of his mind, but rather they adhered to some arbitrary rule he had determined

[20] As my illustrious improv mentor JD Walsh phrased it: The "Lord of The Rings" films are masterpieces, but for the most part, they entail horrible things happening to good people. Frodo must walk through Mordor—hell on (middle) earth—in order to save the world. When watching the extended editions of these films, it's over ten hours of nightmarish trials for our hairy footed heroes. However, the first thirty minutes take place in the Shire, with fireworks and celebration. Those thirty minutes help remind us what is at stake should the fellowship fail in their quest. Similarly, if the audience of an improv scene is not given a chance to grow affection for the characters on stage, it is difficult for them to be invested in the conflict they are being presented with. In short: improv scenes should start in the Shire.

(such as whether or not the sentence they asked ended in a vowel, or if he noticed them appearing to get frustrated, or just completely randomly). The rule itself does not matter; what matters is that the entirety of the narrative came from the mind of the improviser who only moments ago claimed they were incapable of telling a story.

People, it turns out, are extremely good at telling narratives, but only under the right conditions. One of these, as illustrated in the above example, is when there is a freedom of failure. By shifting the responsibility of the narrative from them to himself, Johnstone freed the storyteller from fears of the ego; there was no danger of their story not being good enough, or funny enough, or clever or insightful or profound enough. Participants were so eager to figure out his stories that they never stopped to consider that they were actually weaving the stories themselves. Whether or not narrative has a place in improvisational performance is perhaps beyond the scope of this dissertation. However, I have hopefully made clear that improvisational techniques can help one access one's narrative potential, and similarly being familiar with narrative structure at the very least has applications in an improvisational setting.

Works of shared authorship, then, can borrow some of these ideas in order to create these "right conditions" in which people excel at storytelling. Namely, an environment where the player is given a goal (the moral equivalent of "guessing" the correct story), but one wherein the penalty for "failure" is minimal, or better yet, that failure is not even an option.

I also would like to take a brief moment to mention that, as of the time of this writing, there is a potential new candidate for most well known depiction of improvisational performance in pop culture. Mike Birbiglia's film *Don't Think Twice* tells the story of a fictional troupe of New York improvisers, whose format appears to lean much closer to long-form than short; at the top of their shows they ask an audience member to briefly describe a hard day, which they'll use as their suggestion to launch into scene work. If this film does well, perhaps the nation will have a new improvisational pop culture point of reference.

2.3 Closing Thoughts and Coming Next

A lot of material was addressed in this chapter, through a literature review covering tools, authoring environments and philosophies. My goals for this review were threefold. Firstly, I hope that I have provided you some familiarity with the research and practices of others that have shaped and inspired my own work. Secondly, it should hopefully be clear how several of the technologies I discussed could potentially be applied directly towards pieces of shared authorship, either in the form of empowering technologies, or in the form of design considerations, taken from both interactive narrative and performance experiences. Finally, by discussing technologies that exhibit properties of shared authorship, as well as those that do not, the form itself begins to take clearer shape.

In chapter 3, I'll be further specifying the notion of shared authorship through the exploration of eleven dimensions. These dimensions describe qualities found in interactive storytelling practices, that I believe are useful for specifying pieces of shared authorship. Several narrative games and practices are ranked amongst these dimensions, and then are spatially visualized through the use of multidimensional scaling. By doing this, it provides not only a clearer sense of the space of shared authorship as it exists today, but can serve to motivate directions to take pieces of shared authorship in the future.

Chapter 3

The Axes of Shared Authorship

In chapter 2, I covered a fair number of computer science technologies and theatre practices and philosophies that could potentially be applied to a shared authorship context. I have also discussed a handful of games (or, in cases in which the moniker of game is inapplicable, an "interactive narrative experience") which intuitively feel as if they possess some qualities of the notion of shared authorship. In an attempt to pin down with greater specificity the qualities that define a work of shared authorship, I shall define a set of axes, on each of which a game can either score high or low (see 3.1). This will then enable us to see that there are certain qualities that have yet to be explored in previous work 3.3; these are qualities which I am happy to say some progress has been made towards exploring in my own work, which the bulk of the dissertation will be about. These axes are meant to be viewed as specific design dimensions. Whereas the pleasures of shared authorship outlined in chapter 1.2 describe aesthetic goals a piece of shared authorship should[1] strive for, the design dimensions are actionable properties of a game that a designer can implement during a game's design and development to achieve those pleasures.

First though, let us briefly discuss each of the games that I will be charting along the axes.

3.1 Source Experiences

To help us better appreciate the experiences' rankings along the axes, I will briefly describe each of the experiences that make an appearance. Though some of these experiences have already been described in great detail earlier in this document, many will only barely be introduced here and now. Thus, the descriptions presented herein will only be able to provide a trace glimpse into their splendor, and I encourage the reader to add these titles to their "to experience" list for a deeper understanding of what they entail. The titles presented here are in alphabetical order, and span both digital and analog experiences.

I realize that some readers may find these descriptions to be somewhat of a slow read; there are a lot of them, and only superficially capture each experience's essence. So, as you read through them, I encourage you to view them through a shared authorship

[1]Should is such a strong word, and I'm fully aware that a lot of power can be found in subverting or denying traditionally "good" qualities in games. For example, Tracey Fullerton's *The Night Journey* [77] captures the difficult-to-represent sensation of reflection by having players willingly and—crucially and paradoxically—actively relinquishing their agency. I am confident that there are many valuable design spaces to be explored where a piece of shared authorship intentionally foregoes these design dimensions. Perhaps in so doing, even more design dimensions will be determined. For now, if I use language like "should" it is to be interpreted to reference only the short term. We must first establish the form, before we can fully experiment with deviating from it.

lens. I invite the reader to review the eleven axes of shared authorship introduced at the beginning of chapter 1 and the aforementioned pleasures of shared authorship outlined in chapter 1.2; doing so will, I believe, better frame the inclusion of each individual title.

These narrative experiences were chosen because I believe they represent a nice spread of the types of narrative experiences typically being developed today. Moreover, I believe that they demonstrate a range of the pleasures of shared authorship I have discussed, ranging from the quite high to simply not present; some of these pleasures are achieved through the use of technologies outlined in chapter 2. By analyzing the structural differences that distinguish these games, I have proposed the eleven axes—or design dimensions—that I believe disambiguate them, in an attempt to capture a comprehensive space of interactive narrative, collaborative storytelling, and story-game experiences experiences that exhibit varying degrees of shared authorship pleasures that are currently being explored. By capturing this space, I am then better suited to identify which qualities along these design dimensions can be further pushed on to create novel shared authorship experiences.

- **Braid**: This puzzle platformer game by Jonathan Blow [19] tells a story which on the surface appears to be about a young man chasing after a princess. The game's conclusion reveals that both the central character's perception—and the player's—might not be entirely accurate.

- **Choose Your Own Adventure Book**: These were discussed in some detail in section 2.1.1. These stories read like traditionally written texts, except at key moments in the narrative the reader is asked to make choices by flipping to another page in the story (e.g., "if you want to try jumping into the infinite pit of snakes, turn to page 23. If you want to leave well enough alone, turn to page 137"). Many choices result in premature endings, often in the primary character's death (as is likely awaiting our hypothetical protagonist on page 23), and only one path is typically considered the correct or true ending. There are many CYOA books, but *The Cave of Time* [196], the first in the series, is a fair example[2].

- **Community Board: Narrative**: This refers to a method of collaborative narrative more-so than a single experience. Namely, it refers to situations in which a community of people are jointly working on a single story. These tend to be asynchronous experiences. Imagine a hallway in a college dorm, with a notepad in front of one of the doors, with a note encouraging passersby to contribute new sentences to an ever-expanding story. There is nothing enforcing any elements to the story; a spoilsport could easily add a sentence unceremoniously killing everyone off. However, the anonymity in the writing and the ease with which someone could ruin everything makes it all the more satisfying when a complete story is successfully penned.

- **Community Board: Non-Narrative**: This refers to experiences in which a community of people all contribute writing to a single "piece" but the piece in-and-of-itself is not a narrative. One might think of this as signing a hotel guest

[2]For the curious, samizdat.cc/cyoa/#/anim [291] has some truly beautiful visualizations of the possible paths through the story.

book. There might be micro-stories contributed by individuals, and collectively the entire guest book tells the story of all of the guests who've happened to stay there, but each individual contributor is making their contributions independently of what has come before.

- **Dungeons and Dragons**: The classic table top role playing game [93]. In it, one player takes on the role of Dungeon Master while the other players take on the mantle of a party of adventurers. Game rules governing combat simulation and world interaction (a character's strength stat dictates how hard they'll hit in a fight; a charisma score represents how influential the character is in conversation, etc.) underlie a free-form role playing experience, in which players can literally attempt anything they can conceive, and the Dungeon Master determines how best to gauge its success. Adventurers and Dungeon Masters alike have high agency over the course of the narrative, though typically the Dungeon Master is responsible for providing a complete narrative arc in the form of a campaign.

- **Dwarf Fortress**: Considered to be one of the most impressive feats of procedural content generation (as discussed in 2.1.2) to date, *Dwarf Fortress* [2] simulates millenia of history of an entire planet, with attention to broad shaping details such as continents being formed through centuries of erosion and other weather effects, to religions and mythologies being born and spreading, to artists titling novels after or painting canvases depicting culturally important themes and figures. Once the world has been created, players attempt to construct an equally deeply simulated fortress, to protect its dwarven inhabitants from the dangers of the outside world.

- **EMIC LARP**: This was a live action role playing (LARP) experience, inspired by the tradition of Nordic-style LARPs, designed to introduce players to a specific culture. In it, a player is led from childhood to adulthood by a diegetic guide (played by me!), confronted with pivotal moments in their life that highlight cultural differences. Though the overall narrative of the player's life trajectory was set, the improvistional nature of the piece afforded for unique narrative elements and player creativity to be present. Though the project was only performed a few times, more information about it can be found in [130].

- **Exquisite Corpse**: *Exquisite Corpse* is a surrealist game [26] which has many house rules, so I will provide my personal rendition of it. Players write a sentence of a story and pass it along to another writer, who'll write the next sentence. Before passing it on to the next writer, the second writer will obscure the first sentence, so the third writer will only have the context of the second sentence to inform their contribution. What often results is something approaching a stream of consciousness absurdest piece; with local coherence from sentence to sentence but no overarching plot structure.

- **Façade**: Perhaps the most well known and highly regarded interactive drama to date [280, 143, 141, 144], I discussed *Façade* in the context of drama management in section 2.1.7. In this seminal work inspired by "Who's Afraid of Virginia Woolf"

[4], players visit the apartment of Grace and Trip; friends from college who are now not-so-happily married. As the night progresses, the player's actions determine the fate of their marriage. As previously discussed, there are many underlying systems in place ensuring that Grace and Trip behave believably, say things that both make sense given the context of the current playthrough and successfully escalate or deescalate the tension as appropriate, all in the service of presenting a narratively consistent, dramatically satisfying story in which the player has high agency over its outcome.

- **Final Fantasy VI**: The Final Fantasy series is a collection of Japanese Role Playing games [273] that started in 1987 and are still being produced at the time of this writing. Though nearly each entry is a standalone game with very few direct sequels, they typically all cover grandiose themes such as a rag-tag band of unlikely heroes saving the world, good versus evil, magic, and fate. Nearly every entry tells a single, linear story; though many allow the player to explore a large world map, clever gating mechanisms prevent players from venturing beyond where the game intends them to go. Six is specifically chosen to provide a concrete example to discuss, as well as because the player's agency in the game's second act (i.e., "The World of Ruin") is uncharacteristically high for the series. It also happens to be one of my favorite games.

- **Grand Theft Auto: San Andreas**: The often controversial *Grand Theft Auto* [186] series of games asks players to enter a world of crime. The games in this series have primary storylines that are experienced through a sequence of quests. However, the cities in which players are stealing cars and dodging cops have a fair amount of simulation powering them; both physics simulation for believable driving mechanics, as well as virtual denizens of the towns walking around on their daily routines. Players have the means to interact with these systems in order to create memorable situations all their own, not recognized by the game.

- **Hearthstone**: This collectible card game does not contain a narrative in the traditional sense. However, the game designers are on record saying that they have specifically made intentional game design decisions [99] in order to maximize the amount of stories players will have to tell. This is a form of emergent narrative [243]; narrative not strictly understood by the underlying system, yet could only be created through the system's processes. It is for this reason this game is included in the list.

- **The Ice-Bound Concordance**: This masterwork was discussed in 2.1.1 as a major part of my examination of sculptural fiction. Players work alongside KRIS, an artificial intelligence of a deceased famous author to help him/it piece together his great unfinished novel. The elements included not only determine the shape the novel, but KRIS' memories of a former life.

- **IMMERSE**: The IMMERSE project was a research project aimed at teaching soldiers deployed overseas good stranger techniques: universal skills applicable in any culture that can deescalate situations before they grow to the point of violence.

In order to achieve this, a sophisticated AI capable of managing simultaneous character behavior while reacting to player input in real time had to be developed. Though the scenarios developed for this system were scripted, the characters in the scenario would respond to players as they engaged, allowing for significant dynamism. Though never publicly released, more information about this system can be found in [257].

- **Improv (two person scene)**: I discussed various facets of improv in chapter 2.2.3. For the purposes of placing the relatively broad notion of improvisational performance on these axes, I refer to simple two-person scenes with no additional rules or limits placed upon the improvisers beyond, perhaps, being given an initial suggestion that may directly or indirectly influence the scene. Many of these scenes composed together could likely constitute a piece of long-form. In *The Form* parlance, the reality of this scene does not matter, though it might be easiest to think of it as a third degree reality scene (completely fictional circumstances; "traditional" improv).

- **Keith Johnstone's Guess The Story Game**: This game was described in detail in section 2.2.3, and comes from his book *Impro* [109]. Players attempt to guess the content of a story by asking yes or no questions. Little do they realize that there is no story to be discovered; all of the narrative content springs from their own imaginations.

- **Mass Effect**: I discussed *Mass Effect* [17] in chapter 1.1.2. In this role-playing-game, players take on the role of Commander Shepherd, a space-faring hero recently inducted into an elite inter-species organization designed to protect the cosmos. Players recruit allies with whom, through conversation and bringing them on missions, they can eventually develop close—even intimate—relationships with. The game has many branches, but the player is beholden to experience them as they were designed. There was controversy about how all of the player's choices throughout the span of three games ultimately had little bearing on the ending.

- **Method Actor 2000**: This short piece of interactive fiction was developed by myself in 2008 and was never publicly released, so please do not feel too bad if you've never heard of it. Though I've discussed the Brechtian approach to theatre in 2.2.1, this game was inspired by Strasberg's Method [281, 29], in which an actor draws upon personal experience and emotional memory to channel into a role. In it, players assume the role of an actor who must accrue as much life experience as possible before opening night; the more the player manages to live, the more versatile their final performance has the capacity to be.

- **The Secret of Monkey Island**: I discussed *Monkey Island* [85] in section 1.1.1. In this classic graphic adventure, players assume the role of hapless would-be pirate Guybrush Threepwood as he attempts to prove himself on Mêlée Island. Though the game only has a single story for them to uncover, the sequencing of certain puzzle solutions is left to the player, as well as some actions slightly changing events (such as marooning Guybrush's crew by accidentally launching a rock at his ship).

- **Skyrim**: An entry in the Elder Scrolls series of games by Bethesda Game Studios [282]. Though there is a single central storyline told through a progression of quests, the game is a prime example of an open world game, wherein players have the means to explore the world as they see fit. *Skyrim* has many side quests, not directly connected to the main plot but each with their own small stories, that players can pursue.

- **Sleep Is Death**: I discussed *Sleep is Death* [227] in section 2.1.5. In this digital game, players are given a variety of character sprites, set pieces, music, and more to work together to tell a story. One player assumes control over the narrative's central character, the other is responsible for all other narrative elements. The system has no semantic understanding of the narrative generated by its players.

- **SpyFeet**: SpyFeet was a mobile game developed by myself and several of my lab mates in the Expressive Intelligence Studio and Natural Language and Dialog Systems Lab, as an experiment combining natural language processing techniques, augmented reality, and a dynamic quest system aimed at increasing interest in exercise among middle school aged girls. Players complete physical challenges to earn the trust of ethereal animal spirits and uncover the mystery behind odd occurrences in the player's home town. Though the mystery remained unchanging, the dynamic quest system and NLP techniques gave the player the ability to choose which spirits they engaged with. The game was never publicly released, but can be read about here [218] and here [219].

- **Storyteller**: A game long in development, *Storyteller* presents the player with short narrative-based puzzles, which the player solves by placing characters into comic book panes. There are impressive computationally-derived narrative inferences transpiring in this system, for example if two characters are present in the first pane, and only one character is present in the second along with a tombstone, the system will assume it is the grave of the other character. The stories are short enough that the system does not provide much room for player self expression, but exploring the possibilities the game provides remains a delight [13].

- **Telephone Pictionary**: This game is a portmanteau of two popular party games. In *Pictionary*, players draw pictures in hopes that their teammates will be able to guess what it is. In *Telephone*, players sit in a circle and a phrase is whispered from ear to ear; often mutating in the process from giggles and poor articulation. In Telephone Pictionary, players sit in a circle, write a sentence, pass that sentence to their right, and then draw a picture inspired by the sentence they received. These pictures are then passed again and—without seeing the source sentence in an *Exquisite Corpse* like twist—players attempt to capture the drawing with a sentence. The game produces as many stories as there are players; it is a delight to see what elements change and which remain the same.

- **The Walking Dead**: Created by TaleTale Games, *The Walking Dead* marked a notable shift from the company's previous graphic adventure titles by introducing quick-time events, branching choice points, and death. Though the number of meaningful branches present in the game is limited [114], the game does a superb job of convincing players that their choices have impact, due in no small part to conveying an artificially deep memory of its characters via messages frequently appearing after dialogue choices to the effect of "Clementine will remember that."

- **Y.A.R.N**: Discussed in 2.1.5, Y.A.R.N asked players to collaborate with one another to pen a story one sentence at a time. Each sentence is treated as a round of play; at the end of each round, player's vote for their favorite sentence. The sentence with the most votes is appended to the story.

Note that in many of these cases, these titles should be considered exemplars of many other experiences that follow suit. The *Mass Effect* series, for example, is structurally very similar to the *Dragon Age* series [61]. The *Final Fantasy* games are akin to the *Dragon Quest* franchise [102]. *The Secret of Monkey Island* is similar enough to the previously discussed *Quest for Glory* series (not to mention *King's Quest* [317], *Gemini Rue* [187], *Gabriel Knight* [108], *The Book of Unwritten Tales* [80], and many others). Hopefully this helps paint a picture of the current landscape of narrative based games, and in so doing, reveal aspects of shared authorship that are presently being underexplored.

Now that we have a shared understanding of these games, let us introduce some axes with which to compare them.

3.2 The Axes of Shared Authorship

Throughout all of my discussions of the underlying technologies powering these various narrative experiences (or, in the case of non-digital games, the underlying philosophies which make them successful), I have found a handful of design dimensions that seem to disambiguate these experiences from one another. These dimensions largely came from three sources. The first is a personal intuition derived from being a practitioner in the field for the past seven years[3]. The second comes from the games themselves; I attempted to choose enough qualities so that even relatively similar games could be appreciated for their distinctive qualities. The final source comes from the literature review in the last chapter; there were distinctive qualities of several of the systems that were addressed—say, for instance, the desire for the drama manager to be an invisible process to the player—that have been directly represented in these axes (in this example, namely the "visibility of the collaborator" axis). After I introduce the axes themselves, to help show their utility, I will present the results of finding Pearson's r for each pair, to help reveal the orthogonality of each axis.

By teasing these dimensions apart, it will provide us with a means to measure certain games against each other. Moreover, it will provide us with the ability to note if there are certain qualities not present in any of the games explored; allowing us to contemplate why such games do not yet exist, and providing specific directions that game designers can push on to create works that evoke the pleasures of shared authorship. If the culprit

[3] And a consumer of the field since I was three years old, having played all of these games and others like them

behind the absence of such games is a fundamental lack of requisite technology, it will provide motivation—and an artistic guiding light—to produce it. To this end, I will use multidimensional scaling to reduce the 11-dimension space the games presently reside in to a much simpler to visualize two dimensional domain. Doing this enables us to quickly see which of my source experiences are most similar to one another, as well as hint at potentially fruitful areas of unexplored design space.

The axes on which I will be rating these games now follow; the actual ratings will occur in section 3.3.

1. **Direct Human Collaboration**: This dimension refers to the degree that the player appears to be collaborating with another human. To rank highly across this dimension, the narrative experience would involve players directly working alongside another human to create the finished product—or for the experience to provide convincing ersatz humans to work with, likely in the form of believable agents. Improv scenes and Keith Johnstone's game score high on this dimension, as both include a direct back and forth between two (or more) people. *Sleep is Death*, *Exquisite Corpse*, and *Telephone Pictionary* are examples of games that would score relatively high as humans are still the primary contributors, but contributions are made independently and then revealed to the next player with no opportunity to impact them, and—in the case of *Sleep is Death*—players aren't directly working with each other, but are rather collaboratively editing a shared virtual space. Purely digital, single-player games such as *Mass Effect*, *The Walk-*

ing Dead, and *The Secret of Monkey Island* would score low along this dimension; *Façade* would score marginally higher, as it is a system attempting to simulate dynamic, believable humans that can respond in real time to the player's actions.

2. **Collaborator Performance Capability**: This dimension refers to the opportunity for one's collaborator to physically express themselves, through gesture or voice. Once again, improv based experiences score high, though *Façade* scores high as well, as Grace and Trip have physical actions, vocal modulations, and facial expressions that are dynamically determined by the context of the player's interactions. Meanwhile, *Sleep is Death* scores fairly low, as players have very little opportunity for expressivity, and the digital characters they manipulate have limited expressive range; the characters (and their player puppeteers) greatly rely on the words written in speech bubbles to convey emotional state.

3. **Level of Immersion**: A highly immersive experience attempts to hide the fact that a player is playing the game; and hopes to transport them to the virtual world. This typically means that user interface elements that might expose the underlying systems—such as player's health, their progress, or their score—are only present though diegetic means. For example, the player develops the sense that Trip likes them more than Grace by virtue of the fact that Trip is smiling and Grace is scowling, rather than there being some text that overtly displays "Trip amiability score: 92%, Grace amiability score: 21%." Consequently, *Façade* scores very high as an immersive experience, as does most live performance, and,

as one might expect from the name, the IMMERSE project. Though there are some menus, games such as *Mass Effect* and *Grand Theft Auto* also provide a fair degree of immersion by allowing the player to navigate characters freely in richly realized three dimensional worlds. *Drawf Fortress*, on the other hand, is an example of a game with low immersion, as the depictions of the characters and the worlds are highly stylized (the world being represented with punctuation symbols such as "#", "@" and "*"), though the world is richly simulated, its abstracted representation makes it difficult to "lose one's self" within it. But, that segues nicely into the next dimension...

4. **Level of Simulation**: Level of simulation refers to both the breadth and depth of physical, social, and emotional dynamic systems at play, their ability to influence one another and the game, and to in turn be influenced by the player. *Dwarf Fortress* trumps most other simulation heavy experiences, with detailed models at both broad levels (e.g., world mythologies being generated and influencing entire cultures) and micro levels (e.g., tracking the poison coursing through a dwarf's veins after being bitten by a venomous snake). *Façade* is also heavily influenced by simulation; involving not only a simulation of human beings, but constantly analyzing the generated story thus far to determine what narrative beats would be best to introduce next. Games such as *Mass Effect* and *The Walking Dead* have some level of simulation as they must keep track of the player's choices to determine how characters should respond to dialogue choices. *Braid* and *Grand*

Theft Auto, though not directly simulating narrative, have physics simulations which can help contribute to the game's emergent narrative. *Monkey Island*, *Sleep is Death*, and the live performance experiences have next to no simulation.

5. **Distinct Producible Play Traces**: This dimension refers to the number of unique stories these narrative systems are capable of generating. There is some underlying notion of referring to meaningfully distinct play traces. For example, in *Monkey Island*, players could spend any length of time visiting the various locales of Mêlée Island, without talking to a single character or solving any puzzles. This could result in great variety in the length and content in different playthroughs (e.g., one player entered and then immediately left the circus thirty times; another did so four hundred times), but as this does not advance the narrative of the game at all, it is difficult to consider these differences narratively significant, beyond enabling a form of emergent narrative which games like *Grand Theft Auto* and *Hearthstone* provide with higher fidelity to their underlying dynamic systems. The improvised experiences and games that involve very little computer interaction (*Exquisite Corpse*, *Dungeons and Dragons*, and to a lesser extent *Sleep is Death*) conversely offer a near infinite amount of possible narratives. Capturing this phenomenon in a digital experience is one of the major challenges for shared authorship.

6. **Visibility of the Collaborator**: This dimension refers to how easy it is for one to recognize that they are, in fact, working in tandem with another force (be it

a human or system). If it is plain to see that there are other creative forces at work (such as in *Dungeons and Dragons*, improvisational performance, *Exquisite Corpse*, and *Sleep is Death*), then the game will earn a high ranking across this dimension. If the collaborator is invisible, or the game otherwise actively attempts to hide their existence, then games will score low (such as in *Façade*, *Mass Effect*, *Storyteller*, and *SpyFeet*).

7. **Reliability of the Collaborator**: This is a spin on the literary notion of the unreliable narrator [188], in which the often objective and omniscient narrator of the story either purposefully or accidentally provides the reader with false information pertaining to what most would assume to be unbiased narrative facts. The unreliable collaborator, then, is a collaborator that claims to be fulfilling a certain goal or achieving a certain effect, when in truth they are not. Most of these narrative experiences assume reliability; a notable exception is *The Walking Dead*, in which the system regularly checks in with the player to assure them that their choices matter, when in truth those choices might have little to no impact on the underlying simulation [27]. Though one would intuitively think that a reliable collaborative partner is preferred, *The Walking Dead* proved that this is an interesting design space deserving further attention.

8. **Number of Distinct Game States**: This dimension refers to how much "stuff" there is in a system for the player and their potential collaborators to work with. In other words, this is the number of different types of states that the player can

get the system into that the collaborator can reason about, act upon to make further changes, and then allow the player to respond to in kind. The more potential states that can meaningfully impact the course of the narrative, the higher the game will rank on this dimension. *Façade* is an example of a game that ranks highly here, as there are many aspects of state that the system can reason about; including the affinity Grace and Trip are individually feeling towards the player, the many different ways that the player's parsed text can be tokenized and understood by the system, and the library of dramatic beats that the system determines are best to introduce based on the action that has transpired thus far. Conversely, a game that would score low on this axis is one which does not keep track of much internal state, such as *Sleep is Death* or *Braid*.

9. **Wide Possibility Space and Convergence**: This dimension is referring to a notion inspired by Mick Napier regarding an improv scene [178]. When an improv scene begins, it is as if one is working with a blank canvas; there is a very broad possibility space, as the scene can essentially be taken in an infinite number of different directions. However, with each choice that is made by an improviser, it cuts the possibility space tremendously. For example, when a two person scene begins, the characters of the two improvisers can potentially have any imaginable relationship with another. The instant that a relationship is established (say, siblings), then the possibility space of the scene has been immediately and dramatically reduced by preventing it from being a scene featuring a parent-child relationship,

student-teacher, or co-workers, or anything else.[4] As the heat and weight are established in a scene (see 2.2.3), that further curtails the amount of possibilities that can be explored. Every single character choice and offer—as grand a gesture as a scream, or as soft as a breath—continues to cut this possibility space. When the lights go out and the scene is over, only a single possibility remains: the scene that was just created. For a game to score high along this dimension, it must offer a similarly wide possibility space for initial directions the story can be taken in, with every choice meaningfully paring this space down. *Façade* is a good example of a game that provides this. *Mass Effect*, *The Walking Dead*, and the *Secret of Monkey Island*, however, appear less like funnels, and more like tubes; there are a relatively near constant amount of choices from the beginning to the end; the possibility space of the player's moves remains unchanging.

10. **Visibility of Story State:** This is referring to how obvious or apparent the system makes the status of the underlying state which it then uses to inform its narrative. Immersive experiences tend to shy away from this, presenting state through alternative, often diegetic means. Though potentially immersion shattering, having story state be readily visible and accessible might enable one to more easily manipulate the story to suit their own creative tastes.

11. **Cohesion of Finished Product:** This refers to how easy it is to recognize

[4]Of course, one could easily imagine a scene where the siblings are co-workers at the family business, or one sibling is a know-it-all trying to educate the other. Regardless, even if those additional wrinkles are revealed to make the relationship more nuanced, it does not change the fact that they are siblings, which should influence the way the characters behave around each other were they, say, unrelated co-workers.

the individual voices of the collaborators in the final artifact produced from the experience. When Cyrano and Christian conspire to write a letter to Roxanne in Rostand's *Cyrano de Bergerac* [228], they produce a single letter that an outside party would not consider to be a work of collaboration[5]; this is a piece of high cohesion, as all collaborators are channeled into a single voice. A low cohesion piece is perhaps best seen in community board experiences, in which each distinct contribution is easily recognizable as a separate entity.

Now that I have introduced these dimensions, let us take a moment to rank the games along these dimensions, and attempt to discover currently unexplored game design space. These rankings were produced by myself. Each source experience was rated on each dimension on a scale from one to four, with four meaning that the particular dimension is very present in the source experience, and one meaning that the dimension is barely present, if at all.

	Human Collaborator	Performing Collaborator	Immersion	Simulation	Playtraces	Visible Collaborator	Reliable Collaborator	Game States	Space and Convergence	Visible Story Values	Cohesive Final Product
Braid	1	1	2	2	1	1	2	2	1	1	4
CYOA Book	1	1	2	1	2	1	4	1	3	3	4
CB: Narrative	4	1	1	1	4	2	4	1	1	1	1
CB: Non-Narrative	4	2	1	1	4	4	4	1	1	1	1

[5]This is, perhaps, aided by the fact that Cyrano wrote the letter on his own and they simply claim it comes from Christian, but the anonymity of the collaboration remains the same.

Dungeons and Dragons	4	4	2	2	4	4	2	3	4	1	1
Dwarf Fortress	1	1	1	4	4	1	4	4	1	1	4
EMIC LARP	4	4	3	1	2	4	3	1	2	1	2
Exquisite Corpse	4	2	1	1	4	4	3	1	1	1	1
Façade	2	3	4	4	4	1	3	4	4	1	2
Final Fantasy VI	1	1	2	2	1	1	4	1	1	1	4
GTA: San Andreas	1	1	3	3	3	1	4	2	1	1	3
Hearthstone	2	1	1	2	4	4	4	4	3	1	2
Ice-Bound	1	1	2	3	3	1	4	4	4	3	3
IMMERSE	3	3	3	4	2	4	3	2	3	1	4
Improv scene	4	4	4	1	4	4	4	1	4	1	1
KJ's Guess the Story	4	3	3	2	4	4	1	1	1	1	2
Mass Effect	1	2	3	2	1	1	4	2	1	2	4
Method Actor 2000	1	2	2	2	2	1	4	2	2	2	4
Monkey Island	1	1	2	2	1	1	4	1	1	1	4
Skyrim	1	1	4	2	3	1	4	2	1	1	3
Sleep is Death	4	2	2	1	4	4	4	1	1	1	1
SpyFeet	1	1	2	2	2	2	4	2	3	1	4
Storyteller	2	3	2	3	2	2	4	3	2	3	4
Telephone Pictionary	3	2	1	1	4	1	3	1	1	1	1
The Walking Dead	2	1	2	2	1	2	1	1	1	2	3
Y.A.R.N	3	2	1	1	4	3	4	1	2	1	4

Table 3.1: Ranking the games described in 3.1 across the dimensions of 3.2

3.3 Game Rankings, Axis Orthogonality, A Visualized Design Space, and Discussion

Before digging into the game rankings themselves, now that I have measured a variety of games across these dimensions, I can derive a better sense of the orthogonality of each of the axes. By orthogonality, I refer to how highly correlated one axis is with another. If an axis is highly correlated with another, it means that as one axis' value increases, so too will the other. This implies a redundancy between the two axes, and hints that one could be culled from the list. Likewise, two axes that are heavily negatively correlated speak to a similar phenomenon; as one goes up, the other goes down, meaning that the model requires only one of the two to present the full range of information the original two were capturing. These correlation values are the computed Pearson's r, ranging from negative one to positive one.

Dimension Pair	Pearson's r
Simulation / State	0.8201310641
Human Collaborator / Cohesion	-0.7690256989
Human Collaborator / Visible Collaborator	0.7664661691
Play Traces / Cohesion	-0.6379472895
Human Collaborator / Performing Collaborator	0.6324686721
Performing Collaborator / Visible Collaborator	0.5826348951
Human Collaborator / Play Traces	0.552967444
Visible Collaborator / Cohesion	-0.5425382826
Game States / Space and Convergence	0.5305064804
Play Traces / Visible Collaborator	0.4865722924
Performing Collaborator / Cohesion	-0.4697569301
Game States / Visible Story Values	0.4558704991
Performing Collaborator / Convergence	0.4194412515
Simulation / Visible Story Values	0.4124054241
Human Collaborator / Simulation	-0.3734277268
Human Collaborator / Visible Story Values	-0.3709763429
Performing / Reliable Collaborator	-0.3654002061
Human Collaborator / Reliable of Collaborator	-0.3510208939
Simulation / Space and Convergence	0.3418523776
Human Collaborator / Game States	-0.3174302447
Performing Collaborator / Immersion	0.2962279106
Immersion / Simulation	0.2962279106
Space and Convergence / Visible Story Values	0.2936655941
Immersion / Play Traces	-0.2916059218
Reliable Collaborator / Cohesion	0.2775343832
Performing Collaborator / Play Traces	0.268743418
Play Traces / Game State	0.256271743
Visible Story Values / Cohesion	0.2547546779
Simulation / Cohesion	0.2537100131
Visible Collaborator / Reliable Collaborator	-0.250438048
Play Traces / Space and Convergence	0.2471887644

Immersion / Visible Story Values	-0.2037847865
Visible Collaborator / Space and Convergence	0.1888843634
Immersion / Visible Collaborator	-0.1554591965
Immersion / Space and Convergence	0.1513715857
Reliable Collaborator / Visible Story Values	0.1498708303
Simulation / Visible Collaborator	-0.136785856
Performing Collaborator / Simulation	0.1206693569
Visible Collaborator / Visible Story Values	-0.1182728182
Immersion / Game State	-0.1141336374
Immersion / Reliable Collaborator	-0.1125668564
Human Collaborator /Immersion	-0.1083590466
Performing Collaborator / Game State	0.1069384144
Play Traces / Visible Story Values	-0.09983374885
Space and Convergence / Cohesion	-0.08830830524
Simulation / Reliable Collaborator	-0.07153295388
Reliable Collaborator / Game States	0.06395282022
Play Traces / Reliable Collaborator	0.0612736356
Human Collaborator / Space and Convergence	0.06123592797
Visible Collaborator / Game States	-0.0579608703
Game States / Cohesion	0.05647762568
Immersion / Cohesion	0.05580876222
Reliable Collaborator / Space and Convergence	0.04983084755
Simulation / Play Traces	0.02565790029
Performing Collaborator / Visible Story Values	-0.01878076403

Table 3.2: The Pearson's r for each pair of dimensions, ordered by magnitude. Large positive numbers indicate the two dimensions are positively correlated, large negative numbers imply negative correlation; both imply redundancy.

Table 3.2 presents the Pearson's r for each pair of dimensions. Although the majority of the dimensions appear to be orthogonal—and thus capture fundamentally different information about our source experiences—there are a few dimensions that are highly positively and negatively correlated.

With a Pearson's r of over .82, the most correlated pair is the amount of simulation a source experience makes use of, and the number of unique game states. This intuitively makes sense; if a source experience must process heavy simulation, there seems to be a need for a similarly heavy amount of state with which to fuel its processing. Less intuitive at first blush is the strong negative correlation (Pearson's r of -.769) between the amount of humanity of a collaborator, and the cohesion of the completed artifact. That is to say that, in the source experiences I examined, humans working together are less likely to produce something intelligible than a person collaborating with an autonomous system. However, this speaks less to any lack of cohesion on humanity's part, and more to the existing field of digital source experiences that were examined. Since many of the digital source experiences provided narrative experiences that were "on rails," the cohesion of the finished product was all but assured, as there would be little to no variance in said product from player to player. Still, this remains a good reminder towards the development of future pieces of shared authorship; to accurately emulate a human collaborator is to potentially take a hit to the cohesion of the produced artifact (at least relative to narrative experiences designed and written before arriving in players hands).

In fact, the humanity of the collaborator dimension appears in quite a few of the most highly correlated (either positively or negatively) dimensions; it shares the third place spot with the visibility of the collaborator, the fifth place spot with the amount of performance found in the collaborator, and the seventh spot with the number of distinct play traces a system is capable of producing. With all of these correlations, it appears that I may have over-valued the presence of humans in my initial discussion of the dimensions; as their presence or absence as a collaborator is already safely captured by the other dimensions. I glean two insights from this discovery. The first is that attempting to design experiences with purely digital collaborators *is* still very important—even if humans do not by default largely impact the experience, having a purely digital version affords certain opportunities and conveniences that *are* distinct. The other insight is that humans can, perhaps, be leveraged more thoroughly in future pieces of shared authorship; if more pieces were designed around a human component, then perhaps we would see the correlation decrease[6].

To help us get a handle on this information, let us take a look at the space explored by one of the most seminal pieces of interactive narrative made to date: *Façade*. *Façade* scores very high on dimensions 2, 3, 4, 5, 6, 7, and 8. Now, let us take a moment to point out that scoring highly on a dimension does not necessarily correlate to being a piece of shared authorship in that context. Indeed, dimension 3, the level of immersion inherent in the experience, might very well negatively detract from the sensation of shared authorship, since as we have seen in my discussion of several of the underlying technologies enabling interactive storytelling experiences, a high level of immersion often implies hiding information that might influence how the player chooses to shape the story. By looking at *Façade*, it helps us to ask what a game might look like with an equally large simulation space and a similar level of narrative convergence, but with a visible collaborator, where the player is more cognizant of the disposition and predilection of the entities they are working with.

The experiences revolving around live performance that are primarily human driven share many qualities with one another, which is to be expected. On the surface that

[6]And, indeed, chapter 7 details a work of shared authorship that crucially combines human and simulation performance to create a unique experience for the player.

might seem like a null result at best, and irrelevant at worst. However, since so many of the discussed technologies are attempting to emulate or facilitate these experiences that are at present primarily done by humans, it remains useful to see how such experiences rest along these dimensions, so that designers and developers might better target future technologies to enable them. It is, perhaps, to be expected that dimensions 1 and 2—pertaining to the degree of humanity and performance present in the collaborator—would primarily only be present in human driven experiences. However, it can be seen that these same experiences tend to use very little simulation, *Dungeons and Dragons* being a notable exception, though even that systems' amount of simulation is relatively light, as it must be capable of being readily computed by humans. *Sleep is Death* is another middle ground of these experiences; primarily relying on human storytellers to shoulder the bulk of the narrative generation responsibility, but providing a virtual interface to facilitate it. Though Jason Rohrer's approach to "solving" interactive storytelling by simply having humans take care of it feels like it might be addressing a slightly different problem [105], it is certainly true that at present humans have the edge over computers in terms of both storytelling and story recognizing ability. What then, might it look like for a system that is primarily human driven, but that is augmented with deep simulation and many raw narrative components for the simulation to work with?

Similarly, nearly every experience analyzed has a very reliable collaborator; though some games might include characters that are lying, the underlying systems have no capabilities for mendacity.

For the pleasures of shared authorship pertaining to creating something that one feels ownership over, it is important that the system in question supports the production of a vast number of distinct play traces. Again, I believe that it tends to be the human-driven experiences that best afford this; though as seen above, the simulation systems powering *Façade* permit it a good number of distinct playthroughs as well. *Façade* and *Ice-Bound* are also two of the only digital experiences that afford narrative convergence, with the possibility space of the story being carved and focused with every player action.

It seems, then, that a few interesting combinations of qualities begin to reveal themselves. What would a human-driven game augmented by deep simulation look like? How would the simulation inform the narrative and the human players involved? What types of experiences would such a piece enable?

Similarly, what would a deeply simulative, purely digital piece, such as *Façade,* that did not actively attempt to create an immersive experience look like? A game that made no pains to hide the collaborator the player was working with? If the collaborator was framed as an actual writing partner, working together with the player to pen a story, how would that affect the player's perception if the collaborator was instead represented by characters in the story themselves, with their own desires for the direction the narrative goes in, a la the author-centric versus character-centric approaches to story generation discussed in 2.1.3.

To further expand on these thoughts, I have used the technique of multidimensional scaling [236, 235] to better visualize the groupings of games we've discussed, along with the inclusion of a few choice others. This visualization can be seen in figure 3.1. In this figure, the absolute position of the dots is meaningless (a source experience being in the

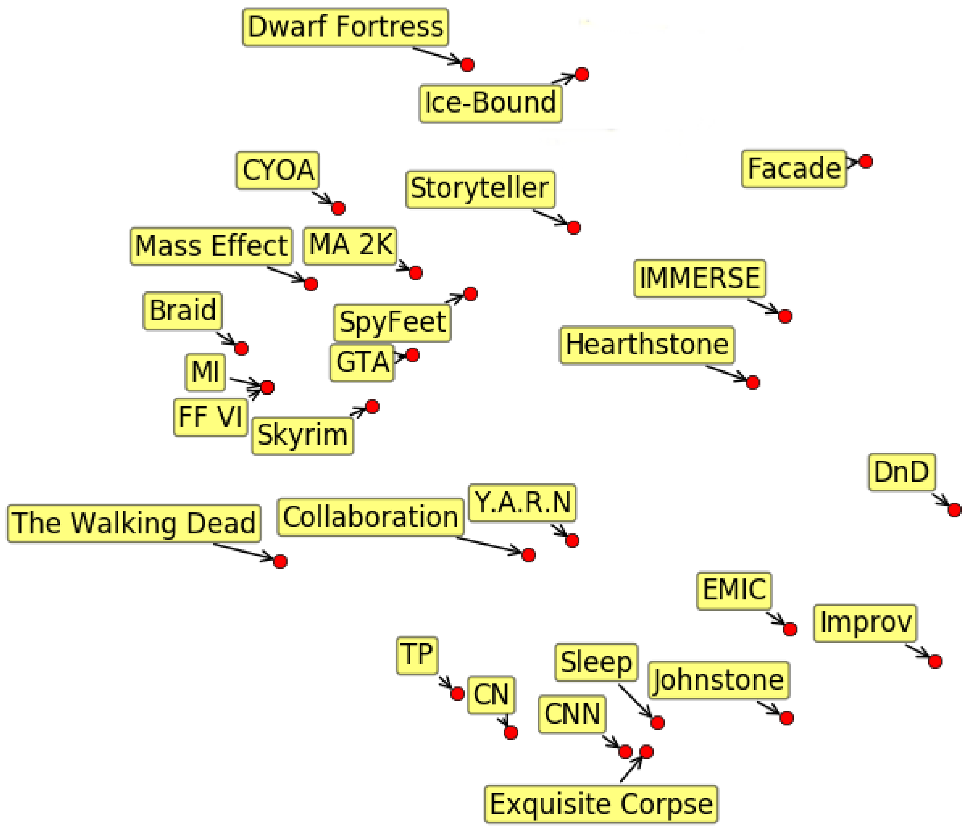

Figure 3.1: A two dimensional visualization of the original eleven dimensional space. One can see clear groupings of like games, as well as largely unexplored design space in the upper right quadrant of the map, boldly being pioneered by Façade.

bottom left corner is no better or worse than an experience being in the top right, or middle). However, the relative positions of the source experiences help illustrate which games are most akin to each other based on their dimensional ratings. Moreover, the figure serves as an actual map, with the portions of it that have fewer games indicating lesser explored areas of design space. Designing a game based on the design dimensions determines where in this space the game is situated; theoretically determining how many of—and how deeply—the pleasures of shared authorship outlined in chapter 1.2

are evoked.

A quick glance at the figure provides a sanity check that corroborates my intuitions—and hopefully the reader's as well. Namely, the bottom of the figure seems to have most of the improvisational based games driven by humans. The left-hand side of the figure is primarily full of games that have stories written by the game designers that players experience, rather than tell themselves (it is, however, interesting to note how the *Walking Dead*, which I would say fits this description quite well, has managed to give itself some distance from its statically written brethren. I would attribute its distinction to the fact that it was one of the few games to make use of the mechanic of the unreliable collaborator). Y.A.R.N. and Collaboration, two games which are very similar to one another, are placed right next to one another.

If you will turn your attention to the upper right corner, you'll see that Façade is in a class all its own. Cutting a diagonal swath across the upper right quadrant, we are left with *Dwarf Fortress*, *Ice-Bound*, and *Façade*. These three games make heavy use of simulation, have a strong emphasis on narrative—either inherent or emergent—and give the player a deep capacity for shaping the course of their story. Façade and Ice-Bound, in particular, are games that I feel evoke the pleasures of shared authorship as outlined in 1.2, and thus future works designed to possess similar ratings will further explore this design space, and theoretically further elicit the aforementioned pleasures. Though all four corners of this image speak towards design spaces waiting to be explored, it is the upper right hand quadrant that I feel shows the most promise for the future of shared authorship.

I hope that you are excited to attempt to explore this design space together with me, because that very adventure is what we will soon be embarking upon; discussing *Prom Week*, *Bad News*—two complete games developed and released by myself and my colleagues—and briefly touching upon an in-development prototype.

During my tenure as a graduate student, I've developed a variety of technologies and playable experiences that experimented in and around these underexplored areas of game design space. The remainder of this dissertation will discuss the three mentioned above in great depth, by first explaining the underlying technologies enabling them, then discussing the playable experiences themselves, and then finally discussing how the piece succeeds and fails as an example of shared authorship; including an examination as to how changes in the technology might have better served the purpose of collaborative storytelling. Though the bulk of the dissertation describes these systems themselves, their theoretical capacities and shortcoming as pieces of shared authorship, and responses towards these pieces from players and critics, it is also important to describe how satisfied the creators of these pieces are with the types of stories being created; several techniques meant to ascertain this are described in chapter 6.

The three playable experiences I will discuss are the social simulation game *Prom Week*, the performance piece *Bad News*, and a prototype mixed initiative storytelling-based playful tool called *Writing Buddy.* Although each of these games share some properties—all of them are powered by rich simulation systems, and some of them make use of different iterations of the same technology—they are all different enough to provide the reader with a breadth of examples demonstrating the potential range pieces of shared authorship can provide. Upon completion, the reader should hopefully have a strong understanding of the versatile potential of the technologies used in these experiences, and will hopefully be inspired to either incorporate these technologies into their own work, or develop technologies of their own to push the boundaries of the medium even further.

We will begin our whirlwind tour with *Prom Week*, and this visit will begin with a deep dive into the social simulation engine that powers it, *Comme il Faut*, and what about its qualities lend itself well to the cause of shared authorship.

Chapter 4

CiF and Ensemble

4.1 An Introduction to Social Physics

Now that I have discussed a variety of technologies that have been applied to pieces of interactive storytelling, and have presented dimensions with which to measure a piece of shared authorship, it now seems appropriate to discuss new interactive storytelling technologies that could help us achieve novel pieces of shared authorship[1].

The first two pieces of technology I would like to discuss are both "social physics engines." I would not be surprised, gentle reader, if you are unfamiliar with the term social physics. Do not fret! This chapter will cover social physics in great depth. However, to give you an idea as to what the notion refers to, imagine if you will throwing a stone into a still pond. Ripples will emanate out from the point of contact, potentially waving across the pond's entire surface. Though the rock only "touched" a single part

[1]The descriptions of these technologies draws on text from prior publications, including [160] and [248].

of the pond, the entire body of water is affected.

The above is how I like to think of social physics. A social act is rarely, if ever, performed in a vacuum. If two people go through a social transition (e.g., major life events such as getting married or divorced, or minor momentary shifts such as going on a date or getting into a fight), it affects not only the way they will interact with each other, but the way those around them feel and behave as well. In turn, the affected behavior of those folks will bear influence on the lives of those around them; this pattern continuously ripples outward, until the amount of social fallout is only peripheral, barely noticeable.

Social physics, then, is a way to capture the fluidity and dynamism of social relationships in a computer program. As we'll soon see, they afford virtual agents the capacity to reason deeply over what actions they would take upon the world, and to in turn be deeply affected by the actions of the player; this two-way interaction smacks of shared authorship.

Before I dive into a tour on social physics engines, I'd like to acknowledge a particular oddness of the chapter; here I will primarily only be discussing the engines themselves, and not the playable experiences they have been embedded in. Though the occasional reference will sneak in, this chapter focuses on the engines; and Chapter 5 explores one of the largest social-physics-powered endeavors made to date in greater depth. If you believe, as I do, that technologies such as this can only be evaluated through implementation—that their merit largely springs from the new types of playable media that they enable—then having a conversation about social physics in isolation from the games they've been embedded in appears a disservice.

Be that as it may, what I am attempting to do here is to disambiguate the capabilities these specific systems—and the metaphors under their employ—have towards the cause of shared authorship. Though related, that is a fundamentally different topic than the successes and shortcomings of a particular instantiation of these systems. That is, a particular playable experience created with these systems is certainly a useful—indeed, invaluable—way to evaluate these systems, but as an artifact any given playable experience can be analyzed in and of itself in how successful it was at being a piece of shared authorship.

I hope that the above has assuaged you in some slight measure. Rest assured, by the time I am through, we'll have covered both system and playable experience in great detail. But for now, let us begin our social physics education with an explanation of the architecture and processes of Comme il Faut.

4.2 CiF

I'll now describe Comme il Faut (CiF)[2], an artificial intelligence system that matches character performances to appropriate social context, with the goal of enabling authors to write high-level rules governing expected character behavior in given social situations, rather than specific fixed choice points in a curated narrative structure. CiF models characters with a complex set of traits, feelings, and relationships, who can form intents,

[2]CiF was originally conceived by my colleague and collaborator Josh McCoy, and further developed by myself, Mike Treanor, Brandon Tearse, Teale Fristoe, and Aaron Reed. Its development was overseen by Michael Mateas and Noah Wardrip-Fruin.

take actions, relate to a shared cultural space, and remember and refer to past events. A set of authored rules encoding appropriate behavior within a specific story world allow these characters to select actions to take (and respond to actions by others) in a manner consistent with their own personal and social concerns as well as a shifting interpersonal context.

CiF was the AI system used as the narrative engine for the game *Prom Week*. *Prom Week* will be discussed in more thorough detail in Chapter 5.

4.2.1 Introduction to CiF

As I have been mentioning since Chapter 1, video games present a tension between storytelling and player interaction that is not present in most forms of media. While other media are static and tell preauthored stories, the interactivity of video games affords the telling of dynamic stories. Though I have been primarily concerned with the notion of shared authorship—collaborations between the player and the game to create a story—all games are in some form a collaboration between the game designer and the player; the player interacts with the game designer's creation to produce a playtrace. As we've seen in examining other games, the interactivity of stories told in video games can potentially range from static stories (much like those told in other forms of media) to completely dynamic stories that are procedurally authored, such as the dream of the Holodeck [177].

Mainstream state-of-the-art storytelling games, such as Final Fantasy XIII [274] and Heavy Rain [209], do not offer many options for the player to influence the story, making them more akin to static rather than fully interactive stories. When present, the player's influence on the story is limited to a more local story impact. As discussed in chapter 1.1, these games employ the "beads on a string" model of interactive narrative [95], which links sequences of narratively motivated gameplay into a linear order, collapsing and eliminating most consequences of player choice each time the next "bead" is reached. Such designs are common because allowing for branching structures at discrete player choice points otherwise creates an exponentially increasing authorial burden, meaning designers tend to avoid structures that allow for real choice, to the detriment of meaningful player agency within an interactive narrative.

Increasing the impact a player has on the story with current methods is problematic. For an interaction to be meaningful, a decision needs to be made by the player that has some impact on the story world; if the player had no impact on the story world, it would not truly be an interactive experience. Every authored point of player interaction increases the number of potential stories. In effect, authoring an interactive story game is authoring a space of possible stories, and playing such a game is exploring one distinct story of the many possible that could be experienced. The key problem is creating a space of stories while ensuring the quality and consistency of each story.

At present, one of the few alternatives to the "beads on a string model" for increasing player impact on a story is a simple brute force approach, as discussed in chapter 1.1.2. Maintaining story quality while accounting for player impact in these large story spaces is accomplished by manually authoring content for every possible state the player could drive the story into. The fallout of this method of creation can be seen in the massive amounts of content authoring needed to realize the story experience of *Star Wars: The Old Republic* [18]. Even with massive authoring efforts, the best current story games still have a weak coupling of narrative with player choice. In this and other games, players are afforded a large amount of play in the spaces of physical interaction and combat while having very little ability to play with the story.

The power of combat and physical interaction in games comes from how their domains are modeled; instead of accounting for every possible state discretely, they are computational models complete with general rules for their domains. They allow for players to interact with a large space of possibilities with the computational model maintaining consistency and causality within that space, such as the platformer physics of *Super Mario Galaxy 2* [184] or the portal gun mechanics of *Portal 2* [305]. Instead of providing a scripted set of choices, the players are provided with a space of play. To make interactive stories live up to their name, and to make the dream of shared authorship a reality, the playability in story games needs to approach that of physical interaction and combat.

Comme il Faut (CiF) is a computational model of social interaction that enables a new class of interactive stories outside the purview of exploration and combat. CiF itself has undergone several iterations; the version described in this document is its most modern incarnation, whose beginnings can first be teased apart in [156]; an even earlier rendition can be read about in [158, 159]. CiF provides playability by focusing on social interaction; the player's actions have deep impact on the social world and can greatly influence the social future of characters in a CiF-powered game. Social relationships are critical to many stories, and are involved in nearly every story [163] which makes CiF an important step toward making stories more interactive.

CiF is inspired by social science ideas—including Goffman's dramaturgical analysis [88]—in its interactive, authorable model of social interaction for autonomous agents. A primary responsibility for CiF is to retarget patterns of social behavior amidst shifting contexts and to modify character performances to be appropriate to the social context. Social exchanges, defined as multicharacter social interactions whose function is to modify the social state existing within and across the participants, are the structures that are retargeted.

Through the use of social exchanges along with additional encoded social context, CiF increases the impact and interactivity a player has on and with the social aspects of an interactive story. Context is encoded when authors specify the rules and general patterns of how social interaction should take place. With the separation of patterns of social behavior from the norms that govern their use, authors can explicitly encode the reasoning of domains of social norms which can be reused across all social behaviors. The encoding of social norms comprises individual rules, each of which encompasses a social consideration. Because of this rules-based encoding, additional domain knowledge can be easily added to the existing base of rules and immediately used by CiF. When the rules are used in conjunction with social exchanges, the character behaviors generated by CiF can be rich and surprising.

To provide the reader with an understanding of how CiF achieves the above, I will dive into a detailed description of the structures with which CiF represents social knowledge and how this knowledge is employed to simulate social interactions between characters in a story world. I will also provide concrete examples of how CiF can be used to enable social character behavior for interactive storytelling in a way that is tractable to the author and flexible for the player. As useful as these examples may be, there is no substitute for examining its use in a fully realized game, and for that, there is no better subject than *Prom Week*. Though there may be the occasional allusion to *Prom Week* in the coming pages, readers interested in a full description of the game must be content to wait until Chapter 5.

4.2.2 Related Work to Social Physics

In Chapter 2 I discussed a bevy of related work that was inspirational and applicable to the notion of shared authorship. Here, I will take a moment to discuss prior research similarly foundational to social physics, and how CiF distinguishes itself from these other systems.

As seen in chapter 2.1.3, narrative generation systems such as *Universe*, *Tale-Spin*, *Minstrel*, and others [122, 165, 301, 294, 50] often model storytelling with general mechanisms, rather than focusing on the intricacies of specific domains. In comparison, CiF does not provide a general mechanism for encoding many domains. Instead, it deeply models the myriad considerations necessary for a character to follow norms during social interactions. As such, CiF is meant to be the social reasoning component used by a narrative generation system. Similar goals have been attempted through analysis of crowd-sourced data to discover common play interaction patterns [191], but the approach of CiF is fundamentally different, driven by a rules-driven AI system rather than pattern matching from a player-generated corpus.

There are many systems in the domain of modeling interactions between characters or virtual humans based on cognitive or psychological models that reason over competing capacities of a prescribed set of desires [7, 136, 260, 210]. CiF is an implementation of an alternate, norms-based vision of modeling what characters should be doing. This approach gives characters the affordance to reason over what desires are appropriate for the situation and then to negotiate between those relevant desires [70]. One advantage of this approach is that rather than authoring each scenario in isolation, narrative content can be created based around general social norms that are reusable whenever that pattern of social behavior comes up.

In comparison to hierarchical task networks [68, 34] and behavior trees [104], the operators (or patterns of social behavior) in CiF make use of larger sets of domain knowledge to judge their appropriateness for the current context. Instead of encapsulating domain knowledge implicitly in hierarchically layered operators or behaviors using a small number of (possibly procedural) preconditions or postconditions, CiF chooses characters' behaviors based on all applicable rules in a large rule base that encodes normal social behavior authored for a particular story world.

Outside of academia, *The Sims 3* is an example of a culturally influential and commercially successful video game that has a highly dynamic social space [65]. Its characters, known as Sims, have traits and desires that inform the social practices (social norms and cluster of expectations) they perform [69]. Two major differences between the systems are in the complexity of the statements of social norms and the use of history in those statements. CiF provides a level of complexity similar to first-order logic, in that parties outside the social exchange can be referenced (x is cheating on y if x and y are dating and there is a third character z that x is also dating) where *The Sims 3* can only reference the two characters in an interaction.

CiF also allows for both backstory (history of the story world before the player is involved) and play history to be used in reasoning and social exchange performance, a feature completely missing from *The Sims 3*. The richer rules found in CiF allow for each individual authoring effort to be more potent while enabling an entire new set of social reasoning for the characters. While still a rare approach, other more recent systems appearing since CiF's initial design use similar complex reasoning over social states, such as Praxis [71], the engine behind the Versu [127] interactive storytelling platform, and *NetworkING* [206], which uses a simulated social state to feed a narrative generator.

4.2.3 Comme il Faut System Description

Comme il Faut is a French phrase which translates to "Being in accord with conventions or accepted standards." CiF is a model of social state, a collection of processes which can reason over that social state, and a framework for defining actions which can alter the social state and ways for those actions to be performed. Though CiF is a powerful tool for social reasoning, CiF in and of itself is not a playable experience. Rather, it is intended to be used as a component of a game which wishes to leverage social dynamics;

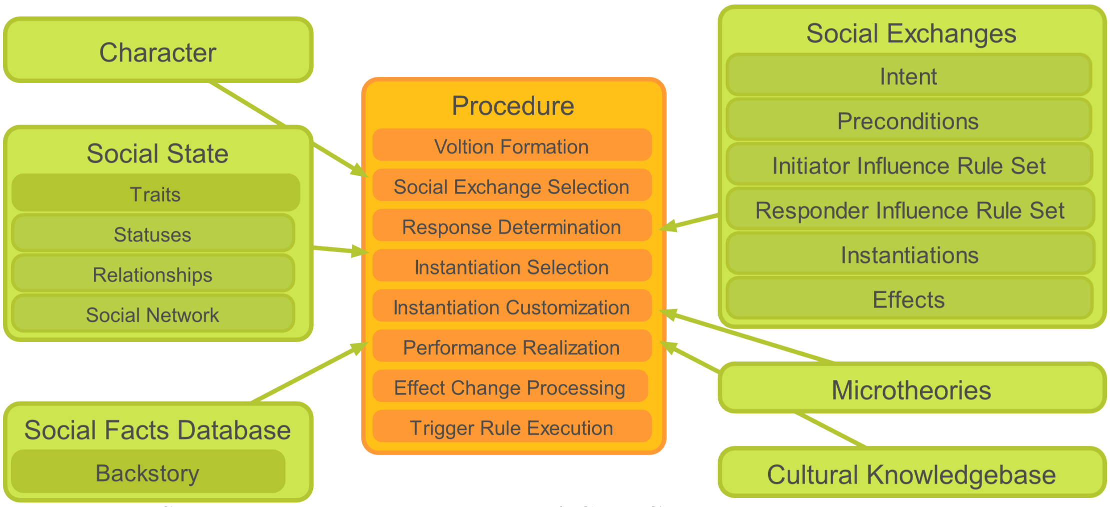

Figure 4.1: System architecture diagram of CiF. Characters, the current social state, the history stored in the social facts database, along with authored social exchanges, microtheories, and the cultural knowledge base are used to inform CiF's procedures. Volition formation determines what social exchange characters want to do with one another. After social exchange selection, which is handled by the playable experience leveraging CiF, CiF determines if the responder will accept or reject the intent of the social exchange. The most salient instantiation is selected, and then customized with NLG templates to be consistent with the social state. After presenting the instantiation through performance realization (again, handled by the game using CiF), the effect changes are processed, updating the social state. Finally, trigger rules are executed, which potentially further change the social state, setting the stage for another round of volition formation.

CiF reports what actions characters would like to take, but it is up to the game that is using CiF to interpret how that should be manifested to the player. What follows in this section is an overview of the elements which constitute CiF's representation of characters, the social state, and how characters might interact with one another to change the social state through social exchanges. I'll also explore the rule system which enables CiF's encoding of social norms, which in turn dictates how characters are inclined to behave toward one another. An overview of the CiF architecture is presented in Figure 4.1.

4.2.3.1 Characters

Due to the emphasis in CiF on social norms and how they guide social exchanges, the representation of each character is thin. What makes characters rich and unique is their relational situation in the social world and their interconnected history. This is a direct artifact of the sociological base of CiF; the model of characters is inspired by the concept of semiotic self where the myriad factors of history, experience, future predictions, and social forces define a malleable self that is not lost in larger societal collectives [9]. The system determines the most salient social influences for a character by considering a full context of social norms, history, and current circumstance. Before covering all of these complexities, I will first focus on the fundamental elements of the social state that help distinguish characters from one another in the system: traits and statuses, relationships and networks, and the Cultural Knowledge Base.

4.2.3.2 Social State

1. **Traits and Statuses:** Traits and statuses are permanent or temporary binary properties, respectively, of a character, which impact how that character performs in the social space. A character might always have traits like brave or intelligent but spend short periods of time with statuses such as depressed or injured. Though structurally similar, by convention traits are immutable, while statuses expire when the conditions that triggered them no longer hold. Statuses can also be directional from a source character to a target character, so a character might temporarily have statuses such as "angry at" or "infatuated with" directed

towards a second character. Though in traditional narratives personality traits often change over time, CiF's focus on short-form narratives means it does not model this.

2. **Relationships and Networks:** Relationships are binary states that specify a significant social connection between a pair of characters. For example, two characters might have the relationship of "housemates" or "rivals." Relationships are nonexclusive (e.g., a character can have multiple rivals) and nonrestrictive (e.g., a character can have a housemate who is also a rival). Relationships work in conjunction with bidirectional, scalar valued social networks. For example, one housemate may have a "respect" network value of 30 toward her rival, who reciprocates with a respect value of 85; here the rivalry is reciprocated, but the respect is not.

3. **Cultural Knowledge Base:** The cultural knowledge base (CKB) is a way to further define the world that CiF-driven characters inhabit, by providing them with a variety of concepts and objects from the story world's cultural context. CiF authors can specify both the items themselves and the ways characters can relate to them, such as desire, ownership, or subjective opinion. For example, the CKB for a CiF game inspired by *Garfield*—star of comics and cartoons, see [53]—might include "Mondays" and "lasagna." If the CiF author had defined the connection types "loves," "hates," and "has," they could set a starting state in which Garfield "hates Mondays," "loves lasagna," and "has lasagna."

In addition, CiF authors can link each item to a single adjective which defines an opinion considered universally true about that object. For instance, the author might say that Mondays are "boring," a cultural construct that all characters in this particular world agree exists, even if their personal opinion differs. Garfield's hapless owner Jon might still "love Mondays" in spite of the perception that they are boring. This complexity of representation opens up a powerful expressive space enabling characters to operate within a cultural context.

4.2.3.3 Social Exchanges

CiF uses the above representations of characters and social state to determine how characters should interact with one another. A social exchange is an attempt by one character to change the social state between him and another character. For example, in a CiF story world about Napoleonic warfare, a general (the initiator) might wish to forge an unlikely alliance by gaining an "ally" relationship with a commander from the opposing side (the responder). This desire, or volition, of the initiator results from CiF's evaluation of the current social state. The responder will choose to either accept or reject the proposed social exchange based on their own relation to the social state in a process of response determination. For example, some factors that might have influenced the general to seek this alliance could include a mutual love for philosophy (CKB), and their feeling weary of war (status). If the opposing commander accepts the exchange, it may be because the general has recently acted with honor toward them (a social facts database (SFDB) entry; see below) and greatly respects them (network value).

Every social exchange authored for a CiF story world has a single primary intent, or intended change to the social state. Multiple social exchanges for the same intent define narratively distinct ways of achieving the same social outcome. The intents, and thus the social exchanges, a character wants to pursue are recalculated after every social exchange in a process called "volition formation." For each pair of characters, volition formation ranks all possible intents and exchanges based on a hand authored set of social influence rules. Each rule has a weight value which adjusts volition for either a specific social exchange or for an intent (and thus a set of social exchanges) either positively or negatively. In fact, a majority of rule authoring in CiF involves these specific intents, or microtheories; these are discussed thoroughly in Section 4.2.3.5. In the example above, one rule might give a higher weighting to accepting a "start ally" intent if the responder has a high respect network value toward the initiator. Another rule might have a strong negative weight for the same intent if the two characters have traits representing allegiance to opposing sides of the war. As these examples imply, rules are domain specific and in aggregate allow characters to behave appropriately within a specific story world's social context.

Each social exchange is only possible within sensible social contexts. To enforce this, CiF has social exchange preconditions, which specify under which conditions any given social exchange is possible. In my Napoleonic example, a specific "start ally" social exchange might have the precondition that the initiator and the responder are not already allies. Social exchange preconditions forbid certain situations while social influence rules merely change their likelihood. The selection of which to use can be an expressive tool for authors to communicate social norms in the story world. For instance, if two generals from opposing sides can never be allies (because of a hard social exchange precondition) it implies a very different social possibility space than if that situation is unlikely but still possible (because of soft influence rules). One use for preconditions is to distinguish different social exchanges which share the same intent. Starting a friendship between two generals on opposing sides might be an "unlikely alliance" social exchange, while starting a friendship between two soldiers could be a "comrades in arms" social exchange. In this example, "unlikely alliance" and "comrades in arms" share the same intent (become friends) but would have distinct preconditions, and possibly different side effects to the social state though unique instantiations.

Instantiations provide a way for CiF authors to have a single social exchange capable of being performed in multiple ways. This not only provides variety, but also can demonstrate subtle nuances between differing social states. Every social exchange can have an arbitrary number of instantiations, and each instantiation narrates a specific instance of a social exchange to the player. Instantiations are intended to be the primary way in which the player learns about changes to the social state. Instantiations have their own set of preconditions, separate from social exchange preconditions. While social exchange preconditions dictate which social exchanges are possible within the current social state, instantiation preconditions determine which instantiations are allowed within the current social exchange. Each instantiation performs either an accept or a reject of the proposed social exchange (since, as was discussed above, the responder can choose to either accept or reject the initiator's intent). Once a social exchange has been selected between two characters, CiF determines which instantiation of that exchange to play in the process of instantiation precondition evaluation; in order for an instantiation to be considered, all of its preconditions must evaluate to true. If multiple instantiations are deemed valid, the most salient instantiation is selected. Salience value is generally correlated to the complexity, or strictness, of the instantiation precondition; the more complex the instantiation precondition, the more social state knowledge can be embedded in the instantiation's authored content, thus in theory making it more interesting for presentation to the player.

Instantiations are one of the primary ways CiF takes advantage of retargeting social behavior; any given instantiation can be played between any pair of characters in any social state allowed by both the instantiation preconditions and the preconditions of its corresponding social exchange. The term retargeting is in wide use in computer graphics and animation [292]; it is introduced here to describe a similar concept in the domain of interactive narrative. Although this is extremely powerful, it can also be difficult to author for, as any given instantiation can appear in a potentially large variety of social contexts. Since instantiation and social exchange preconditions are the only social facts the author can guarantee to be true at the time of instantiation performance, the more complex the preconditions, the more specific elements to the social state the author can reference in the instantiations realization, often resulting in richer performances. Regardless of the complexity of the instantiation chosen, CiF will customize it to ensure it is consistent with the social state at the time of the instantiation's performance. The nature of the performance is determined by the system or game using CiF.

In addition to unique preconditions, every instantiation has its own postconditions or effect changes on the social state. These generally take the form of adjusting network values between the characters involved in the social exchange by a fixed amount, starting or ending relationships, or bestowing or removing statuses. There is no limit to the number of effect changes associated with a particular instantiation, though only characters directly involved in the social exchange are permitted to be directly affected. The social state of other characters may be affected by the social fallout of an exchange through the use of trigger rules, discussed more thoroughly in 4.2.3.5.

Typically CiF authors will match up the effect changes of an instantiation with the intent of the social exchange it is affiliated with. To continue the Napoleonic example: instantiations for the social exchange "unlikely alliance"—which has the intent to begin a friendship relationship—will likely at the very least establish a friendship relationship between the initiator and the responder if the instantiation is marked as accepted, and deny the relationship if the instantiation is marked as rejected. However, this is merely a convention, and CiF authors are free to author outside of this convention if deemed appropriate for the stories they want to tell. That said, at minimum each social exchange should have at least two instantiations: one for the case in which the social exchange is accepted, and one for when the exchange is rejected.

The influence rules, social changes, and instantiation performances—when considered in concert—provide the real encoding of the authorial intent of the social exchange; the name is simply a label that should be succinct and readily evoke the domain of the exchange. An authoring advantage of the social exchange abstraction is that additional detail can be added to the social exchange by simply adding more effect and instantiation pairs.

4.2.3.4 Social History

In fiction, a character's actions are informed not just by the present social situation but by his or her memory of actions in the past taken by both himself and others. CiF represents this with an SFDB that records all actions taken in the story world in a form that can be referenced by both influence rules and instantiation performances. CiF does not simulate hidden information: all events that occur are assumed to be immediately known about by all characters.

To achieve this, instantiations are given three pieces of metadata. The first is the time that social exchange took place. The second is a performance realization string that allows the attached event to be described in natural language from the point of view of any character. By using basic natural language generation (NLG) templates (described in detail in Section 4.2.3.7), the system can swap out names and pronouns to produce texts like "Alan stole Bill's watch," "you stole my watch," or "I stole your watch" depending on the characters involved in the instantiation's performance. The third piece of instantiation metadata is a set of SFDB labels that place the event in one or more author-defined categories. These make it possible for rules to query about whether certain types of actions have been recently performed, at a granularity defined by the author, and for instantiations to request an example of an action that meets either broad or specific criteria.

For example, in a Napoleonic story world, a character might have "offered insult" to another character, a social exchange with the intent "start rivalry." Perhaps the instantiation chosen has the performance realization string "*%i% made scandalous remarks about %rp% mother.*" Here, %i% is a placeholder token indicating the initiator, and %rp% means the responder's possessive pronoun. At the time the scene is narrated, this text might be realized: "Alphonse made scandalous remarks about Jean-Pierre's mother." This instantiation might also be given the SFDB labels "risque" and "cruel."

Later on, CiF might be considering whether the insulted character (the responder in the above example) is willing to accept an offer of friendship from the person who insulted him. In addition to all the considerations described above related to the current social state, there might be influence rules related to information in the SFDB. For instance, one rule might lower a responder's volition to accept a "start friendship" intent if the initiator has recently done something "cruel" to him. ("Recently" can be defined precisely in the rule: some possible alternatives include "in the past x turns," "y times in the past x turns," or "at any point during this game session.")

Furthermore, the existence of this past cruel behavior in the SFDB might influence the selection of an instantiation narrating the responder's rejection in a way which specifically references the cruel event. The SFDB label can be referenced in another NLG template to allow for characters to refer to specific incidents by name. So, for instance, a line of instantiation dialog like "You really expect me to accept your offer after %SFDB_(cruel, i, r, 7)%?" might be realized at runtime as "You really expect me to accept your offer after you made scandalous remarks about my mother?" The parameters to the NLG template requesting an event from the SFDB are the event's SFDB label, the event's initiator, the event's responder, and the time window, here seven turns. The result is a dynamically customized line of dialog that inserts a reference to an appropriate event within the current playthrough in an appropriate place.

In addition to events generated at runtime, the SFDB can also be prepopulated with events representing the backstory that was supposed to have happened before the game began. These events look identical to runtime events stored in the SFDB, except with negative time stamps (assuming the first turn of a given playthrough begins counting at 1). This allows instantiations to begin immediately leveraging both rules and instantiations representing past character actions, which allows for introducing significant past events between characters naturally as they come up in dialog narrating present social interactions. As the player builds up an SFDB of more recent events, these begin to take precedence in both rule considerations and dialog references.

4.2.3.5 Rule System

CiF's rule system is the mechanism by which social reasoning is encoded. A rule detects a specific condition in the social space in the process of rule evaluation. Any of the aforementioned aspects of social state (relationships, traits, networks, CKB, SFDB, etc.) can constitute the left-hand side (condition) of a rule in the form of predicates. Rule conditions can be composed of an arbitrary number of predicates, allowing for rules of varying complexity. Rules are used throughout CiF in numerous ways, several of which have been discussed above; social exchange preconditions, instantiation preconditions, and influence rules are all encoded as CiF rules. Simple rules with few predicates can be used to capture general cases of the social state. For example, characters with high mutual respect network values will be more inclined to start and accept a "become allies" social exchange. Rules with a larger number of more specific predicates represent very particular aspects of the social state. An example of such a rule could be one that only evaluates to true if a character named Demetrius has been involved in at least three instantiations marked with the SFDB label "cruel" towards a second character with the status "lovestruck" (or, even more specifically, a character with the trait "Named_Helena").

CiF uses rules to reason over the social world when making decisions about social exchanges. The details of rule implementation can be found in [157], another dissertation to keep you busy after you have finished this one. The rule data structure is used in or as a foundation of every data structure in CiF that needs to query the social world. Even without diving into their structural makeup, we can still hold a rousing discussion of rules, the predicates that form these rules, and several ways in which rules are used.

To add an additional level of utility, CiF allows rules to be created and evaluated externally to its processes. An application that employs CiF can evaluate rules at any time, even the ones created dynamically at runtime. This can be valuable, as it provides a hook for the rich social state of CiF to be accessed in any way the designer wants. For example, in the high school themed CiF-based game *Prom Week* (described thoroughly in Chapter 5), rules are normally used to determine character volitions and response determination (as described above), but they are also used to evaluate each level's goals (e.g., "get Zack a date for prom"). These external rules free game designers to leverage CiF's social state in any way they see fit.

1. **Predicates:** Predicates are the binding between the current social state as modeled by CiF and the authoring of social interaction patterns and social norms. They are representational primitives that can be evaluated for truth in a specific social state. Predicates have three areas for configuration. First is a set of characters or character variables that will bind to characters during evaluation. Next is a predicate type corresponding to aspects of the social environment modeled by CiF consisting of character traits, relationships, statuses, social network values, history in the SFDB, and cultural items in the world found in the CKB, which were described in detail above in sections 4.2.3.2 and 4.2.3.4.

   The final area for configuration determines the details of exactly how the predicate is evaluated: the evaluation mode. A predicate can be evaluated via a few methods. These different modes of evaluation are a key feature as they allow the predicate to capture more sophisticated concepts of social space. CiF supports three modes of predicate evaluation: *true now*, *true in history*, and *times true*.

   In *true now* mode, the rule simply uses the current social state at the time of evaluation to determine truth. This is the default evaluation mode for predicates. SFDB predicates cannot be true now by design, as they specifically refer to past events.

Every predicate other than trait and CKB predicates can be evaluated in the *true in history* mode. True in history determines if the predicate has been asserted on the right-hand side of an effect change or trigger rule in the past. Though SFDB predicates may seem similar to other predicate types using true in history mode, the latter queries states and state changes (such as shifting statuses or relationships) rather than SFDB labels on social exchanges. SFDB labels are meant to capture an impression of a social exchange by literally associating it with labels such as "diabolic" or "kind." Another difference is evaluation efficiency: since comparing a predicate during rule evaluation to all predicates that have taken effect in the past is expensive, marking a subset of the most commonly searched for history predicates as SFDB labels significantly reduces the search space. Last, the specificity afforded by being able to search the history for particular predicates of any type, not just labels, permits greater authorial expression; for example, an author might want to account for a situation where a character increased their "respect" network value toward another character by 33 within the past four turns, as opposed to querying a general label such as doing something "praiseworthy."

The *times true* mode determines how many times the predicate is true in the current social state. For example, to get the status of "popular," a character might need to have the "friends" relationship with four or more characters. This predicate mode simplifies writing long rule conditions. For example, take a rule with four predicates:

relationship(Friends, x, y) and
relationship(Friends, x, z) and
relationship(Friends, x, w) and
relationship(Friends, x, u)

This is asking if there exists a character x that has the "Friends" relationship with four other characters (represented here as y, z, w, and u). This could be rewritten as a rule with a single "times true" predicate. The predicate author only needs to specify a single friends relationship predicate, mark it to use the times true mode of evaluation, and specify the number of times it must be true, in this case four. Times true predicates gain some additional power by permitting the author to specify which character variables should be held static in the character binding process, and which are allowed to change. Making one character static and the other variable allows for evaluating facts about a single character in the social space as in the above example, wherein the author wants to see if a single character has at least four "friends," or if a character has been involved with three "diabolic" social exchanges in general. Making both characters static allows for checking the social state for facts about a specific pair of characters, such as seeing if one character has made three "diabolic" social exchanges with a particular second character. In the above example, one would set the first character variable to be static. CiF would then determine how many characters could be bound to the second character variable to make the predicate evaluate to true. The number of true bindings is then compared to the times true number to finalize the evaluation.

Combining different evaluation types with different predicate types yields interesting results. For example, if an SFDB predicate is evaluated with the times true mode, it will return how many times that particular SFDB label was encountered by the characters assigned to the predicate's roles in the past within a history window, allowing for characters to know, for example, how many times another character has been "romantic" toward them within the specified time frame. Some evaluation modes can be combined. Times true and true in history can be used in the same predicate to perform detailed mining of the social history; CiF could find out how many times a character has been "betrayed" or "abandoned." One could readily imagine a story world in which characters begin to pity, or perhaps superstitiously avoid, a character that has had many bad things happen to them.

2. **Influence Rules:** Most story-focused games model a character's willingness to engage in a behavior with a simple story progression point or characteristic threshold value. To enable greater dynamism, CiF employs influence rule sets (IRSs), sets of rules that alter the desires of the agents to engage in social exchanges. The right-hand side of every rule inside an IRS is a weight that represents how important the rule is in determining intents, where an intent is the intended change in social state after performing a social exchange (e.g., have two characters become friends). Social exchanges have two IRSs, an initiator IRS which determines when a character will (or will not) want to engage in a social exchange, and a responder IRS, which determines whether the responder will accept or reject the intent of the social exchange if someone else tries to engage them. During volition forma-

tion, rules throughout every initiator IRS and in all microtheories (see below) are considered and their weights tallied. The social exchanges with the highest scored weights represent the social exchanges the initiator most wants to perform. A similar scoring mechanism is used for the responder: microtheories and responder influence rule sets are evaluated and their weights tallied to determine if the responder will accept or reject the social exchange.

Influence rules are CiF rules where the left-hand side is a social condition and the right-hand side consists of a scalar value weight. Influence rules can be associated with specific social exchanges or with microtheories. CiF's processes evaluate influence rules. If the rule evaluates to true, CiF adds the weight value to a character's volition toward either the specific social exchange the influence rule is connected to, or, if the influence rule was given a general intent, the weight is added to the volition of all social exchanges which have that intent. Intents can be any predicate type that is mutable, which means the CKB and Trait predicate types are ineligible, as intents imply changing the social world in some way. A few influence rules authored for *Prom Week*, CiF's flagship title, can be seen in Table 4.1.

3. **Trigger Rules:** There are a special set of rules known as trigger rules that are not used in volition formulation. They are fundamentally similar to the effect changes associated with instantiations as they actually change the social state if certain conditions hold true. Unlike effect changes, trigger rules are not associated

Condition (Left-Hand-Side)	Weight to an Intent (Right-Hand-Side)	Description
status(CheatingOn,r,i)	intent(∼relationship(Dating,i,r)) + 15	If someone is cheating on you, your desire to stop dating them increases.
relationship(Friends,i,r) && status(AngryAt,i,r)	intent(network(Buddy,i,r) +) - 5	If you are angry with a friend, your desire to do friendly things with them is slightly lessened.
status(HasACrushOn,i,r) && SFDB(Romantic,r,i)	intent(Relationship(Friends,i,r)) -10	If your crush has done something romantic to you recently, your desire to become friends with them goes down (in favor of becoming "more than friends").

Table 4.1: Three example influence rules from *Prom Week*.

with a specific instantiation, but exist on a universal scope and can be run at any time, usually after a social exchange has been played.

For example, in a story world where characters can have the dating relationship with each other, it might be useful to know if a character should receive the status "two-timer" by dating multiple people at once (this is, of course, assuming a story world where polygamous relationships are not the social norm). Since there may be several social exchanges, each with their own set of instantiations that lead to "dating", authoring without trigger rules would necessitate checking to see if a character is already "dating" someone in every single instantiation that bestows a "dating" relationship, and if they are, giving them the "two-timer" status. With trigger rules, the author need only write a single rule: if a character is "dating" more than one person, give them the "two-timer" status. Now any instantiations that bestow a "dating" relationship can focus solely on that, and if afterwards a character is "dating" two people, the trigger rule will catch it and mark them a "two-timer." Trigger rules are both an authoring convenience and a useful means of enforcing social definitions (e.g., if monogamy is the expected social norm in this story world, characters who date more than one person should be given the "two-timer" status).

4. **Time-Ordered Rules:** During the development of CiF, authoring situations were encountered where temporal reasoning was useful, especially in capturing chains of social state change in history. For example, in the *Prom Week* story world, when a character has a second character do something mean to them, and then a third person is mean to the second, the first character should have an increased desire to start a "friends" relationship with the third, since the third essentially defended their honor. This "knight in shining armor" influence rule would be impossible to capture without encoding its chronology. Time-ordered rules are an alternate evaluation mode for rules that allow for this type of temporal evaluation.

   The time-ordered evaluation mode for rules follows an alternate evaluation path from the default true now mode. Each predicate has a time-order property that places the predicates into time groups (the default time-order value is 0 which means current time). The predicates are evaluated in ascending time-order value and are evaluated in true in history mode. All rules with a time order less than 1 are evaluated without temporal ordering constraints (this is not shown in code as the predicates are evaluated in the default true now mode). Gaps in time-order values are ignored. If there are multiple predicates of the same order in the rule, they must all be true after the next lowest order and before the next highest order.

By using time-ordered rules, authors can craft story worlds where the characters react not only to isolated, individual changes to the social state, but can also interpret sequences of actions as entirely new patterns of social interaction, and respond accordingly.

5. **Microtheories:** While influence rule sets allow for a great deal of power and flexibility, they can become unwieldy and difficult to maintain in complex story worlds and through many revisions. A disadvantage of the big bag of rules approach is that as the number of rules grows too large for an author to keep track of, redundant, overlapping, or contradictory rules may appear. This problem is only worsened if there are multiple rule authors creating content. To help address this problem, CiF breaks rules into sets called microtheories, unified by a precondition.

   Each microtheory contains a set of rules applying to one or more predicates on the social state. A buddy cop story world might include a "partner" relation, and a microtheory for the predicate relationship(partner,x,y). The rules in this microtheory can influence the volition of any social exchange and consider any factor in the social state, but they are only consulted when the first character being considered has the "partner" relation with the second. In effect, the microtheory encapsulates the commonsense reasoning for what it means for that predicate to be true in the current story world: in this case, what it means to be partners in a buddy cop story. Some rules within this microtheory might include: partners are likely to accept "need backup" social exchanges from each other; a partner is likely to want to initiate a "get revenge" social exchange on someone who gave his partner the status "injured"; a partner with the trait "loyal" is highly unlikely to accept a "request reassignment" exchange from a "partner," even one who had recently done something marked as "foolish" in the SFDB.

All rules in microtheories are associated with intents. This means that each rule in a microtheory impacts a character's volition to engage in all social exchanges labeled with that rule's intent. This abstraction permits the initiator and responder IRSs associated with specific exchanges to focus on capturing the nuances which differentiate social exchanges from one another. For example, if a character x had the status "feels superior to" a character y, it would generally negatively impact x's desire to befriend y, which would be encoded in the status' own microtheory. However, when authoring the initiator IRS of the social exchange "give advice," it is reasonable that x might in fact be more inclined to want to give advice to y if x is feeling superior to them. And, given the right social state, "give advice" is a social exchange that could potentially lead two characters to friendship. This provides a sense as to how microtheories and the influence rule sets interplay and complement each other. More complete technical details about the implementation of microtheories can be found in [157].

4.2.3.6 Performance Script Generation

After an initiator proposes a social exchange and the responder accepts or rejects it, a specific instantiation is chosen based on the current social state and several other factors (including which instantiations have recently been chosen). This instantiation needs to be performed somehow to communicate the social results from the initiator's action. While this performance could in theory take on any form, from character animation to an abstract or iconic representation, a common approach is for each instantiation to contain a set of hand-authored sequential lines of dialog narrating and justifying the specific changes to the social state. Because CiF has so much information about the characters, history, and social state, this dialog can make heavy use of template-based NLG to produce responses that are more customized to the player's unique situation in the story world. I'll discuss the template-based NLG of *Prom Week* below, but some of the factors that might go into text variation include gender, character-specific slang or dialect, CKB items connected to a character, SFDB references involving a character, the names of characters with specific relations or network values toward a certain character, and so on.

4.2.3.7 NLG Templates

NLG templates are used to customize pieces of authored dialog to the current situation (see Table 4.2). On the simplest level, this lets characters refer to each other by name: "Hello, %r%!" can become "Hello, Thomas!" (the percent signs wrap the template request, which in this case is "r," for the responder being spoken to in this line by the initiator). Templates can also be used to substitute appropriate pronouns, or vocabulary specific to a certain character: the above line could be further customized as "%greeting%, %r%!" where "greeting" might be defined as "What's up" for a casual character and “Good to see you” for a more formal one. On a more complex level, templates can request natural language representations of items from cultural knowledge or SFDBs. A template like %CKB_((i, “likes”), (r, “dislikes”), “lame”)% is requesting a cultural reference that the initiator likes, the responder dislikes, and the item is generally considered lame. It is assumed the author has given this instantiation a precondition specifying that such an item exists in the current social context. Similarly, requests for references to past actions like %SFDB_(“kind,” i, o, 20)% are able to use the action’s performance realization string to output the correct text (such as “you and I threw Jessica a surprise party”) even in complicated situations like this one involving multiple characters, any of whom might be the speaker or the recipient of an utterance. The “o” in this example refers to “other,” the slot for either a third present character or a nonpresent character who is the subject of discussion, and the “20” limits this SFDB lookup to events that happened within the last 20 turns. With a flexible set of NLG templates used liberally, the particulars of one instantiation performance can vary significantly from one usage to the next, which significantly reduces the potential deadening effect from reusing authored content.

4.2.4 Playable Experiences Using CiF

Although *Prom Week* is the largest game made with CiF to date, discussed in detail in chapter 5, to provide the reader with a sense of CiF’s versatility and utility, let me briefly outline several other projects that have used CiF to varying extent with different game designs and domains.

NLG Tags	Examples and Explanations
Roles	**%i%, %r%, %o%**. The name of the character (initiator, responder, other) bound to the role slot.
Role Possessive	**%ip%, %rp%, %op%**. The corresponding character name in its possessive form.
Role (Subject)	**%is%, %rs%, %os%**. The character name as the subject of a sentence (this lets a character refer to themselves as "I").
Character Locutions*	**%greeting%, %shocked%, %positiveAdj%, %pejorative%, %sweetie%.** Character-specific utterances.
Pronouns	**%pron(ROLE,MALEFORM/FEMALEFORM)%**
SFDB Entry	**%SFDB_(LABEL,ROLE1,ROLE2,WINDOW)%**. Inserts a SFDB reference of a previously played social exchange that matches the label, roles, and occurs in a window of time.
CKB	**%CKB_((ROLE_1,SUBJECTIVE_LABEL1), (ROLE_2,SUBJECTIVE_LABEL2),(TRUTH_LABEL))%**. Inserts the name of an item that matches the specified CKB query.
Conditional Statement	**%if(ruleID,text to display)elseif(ruleID,text to display) else(text to display)%** Inserts text according to rule evaluation. There can be arbitrarily many elseif clauses
Topics of Conversation	**%toc1%,%toc2%,%toc3%**. Either an SFDB entry lookup or CKB item that is determined when the template is first processed and is stored to be used in the rest of the performance. A topic of conversation is metadata to the template and is specified by either a CKB or SFDB NLG tag.

Table 4.2: Templates in CiF's NLG System. A * denotes a template specific to *Prom Week*.

4.2.4.1 Mismanor

One such playable experience created with CiF is *Mismanor* [286, 287]. *Mismanor* is a historical, character-driven fantasy story about six people interacting at a country manor. In contrast to *Prom Week*, which used CiF to create a social simulation with a "god's eye" perspective where the player can have any pair of characters play a social exchange with each other, *Mismanor* creates a first-person experience where the player controls a single character embedded within a specific plot. While all characters were predefined in *Prom Week*, *Mismanor* lets players choose a set of traits for their character when the experience begins, and restricts available options on each turn to those CiF calculates are likely to be performed by such a character within the current social situation. The player can initiate social exchanges which nonplayer characters can accept or reject, but those characters can also make social moves on the player, who in turn chooses to accept or reject their intent.

Several changes were made to CiF to support a more plot-driven style of gameplay. Items and knowledge were added as first-class entities to the system. While these entities cannot initiate social exchanges, they can be the target of social exchanges designed to interact with them, and store information (through traits or statuses) that can be reasoned over in addition to the other components of the social state. An example item might be a "bottle," which has the traits "drinkable" and "alcohol" and the status "full." A social exchange designed to represent drinking might change this status to "empty," and (because of the "alcohol" trait) give the initiator the status "tipsy." Similarly, knowledge encodes information about significant plot points. A set of statuses like "known by Violet" keeps track of who has learned what information, social exchanges based on sharing information can change these statuses, and microtheories can reason over how a character's behavior might change based on what she knows or does not know. Knowledge might also be tagged with classifier traits like "secret": this enables microtheories describing situations such as gossipy characters being more likely to want to share secrets. The state of knowledge during a particular game could even change at runtime with the addition of statuses like "true" and "false."

Mismanor is a research prototype and has not yet been released as a final game. But it demonstrates the flexibility that CiF allows for creating different flavors of narrative experiences using the same core technology. Information hiding, interaction with objects, and progression through a set of plot points were all relatively easy to add by extending CiF to allow for the new static entities items and knowledge in addition to active characters. Once a framework for social reasoning is in place, it can be used to tell a wide variety of possible stories involving reactive characters.

4.2.4.2 *IMMERSE*

The metaphors of CiF were also selected to be a core piece of technology in the *IMMERSE* project [257, 258]. Described briefly in Chapter 3.1, *IMMERSE* was a Defense Advanced Research Projects Agency (DARPA) experiment designed to teach soldiers good stranger behavior. Rather than teach the idiosyncrasies of a specific culture, *IMMERSE* employs social physics to create a world that rewards users for picking up on universal social cues, such as recognizing the gestures and postures of others and mirroring them. Unlike the turn-based *Prom Week*, *IMMERSE* takes place in real time, and the player physically performs social exchanges and otherwise interacts with the world through embodied movement. It is heartening to see that CiF-inspired systems can be used in technology with real-world consequences, potentially even saving lives.

4.2.4.3 SIREN and FAtiMA

In the context of the European research project Social games for conflIct REsolution based on natural iNteraction (SIREN) [321], CiF was used in the design of a training system that would enable children to explore a broad spectrum of conflict resolution strategies in a safe environment. Though the project is no longer actively being developed, CiF was particularly relevant for the system since it explicitly modeled multicharacter social interactions.

CiF was also being paired with Fearnot AffecTIve Mind Architecture (FAtiMA) [126], an agent architecture that treats emotions as valenced evaluations of the world which affect and are affected by goals in a continuous process. In a conflict resolution training system, CiF would be used to directly encode social dynamics extracted from organizational behavior theory while FAtiMA would have a stronger role in creating dynamic scenarios in which agent attitudes change continuously according to real-time user interactions. The combination would allow exploration of a variety of contextual factors related to conflict.

4.2.5 Closing Thoughts of CiF

I have now described CiF, an AI system enabling authorable models of social interaction between autonomous agents. While most previous interactive narratives have been tightly constrained to a few predetermined narrative options, usually offering the player high degrees of agency and freedom only in the context of combat or physics, not story, CiF enables highly dynamic and responsive social and narrative gameplay. The use of rules-based encoding of social norms, cultural knowledge, and appropriate behaviors for a given story world allows authors to explicitly encode social logic into a playable experience, creating rich and surprising character behavior. Retargeting social performances provides a route to making the authoring for such dynamic social spaces tractable.

One of the primary hopes of CiF is that it provides a strong proof of concept that building rules-based social worlds and retargeting social exchanges can become a successful approach for making game narratives more dynamic and responsive. Before discussing how CiF can specifically be applied to pieces of shared authorship, let us first look at another social physics engine designed to provide greater authorial expressiveness: The Ensemble Engine.

4.3 The Ensemble Engine

The Ensemble Engine[3] is inspired by the lessons learned from more than five years building the Comme il Faut (CiF) social physics engine, and a number of games employing it (including *Prom Week*). The Ensemble Engine retains the most successful aspects of CiF, while also making major improvements in areas such as the flexibility of its action structure and expressivity of its rules. The system is authored in an open standard language (JavaScript) and includes an authoring tool to increase accessibility for game researchers and creators. Through these improvements and this dissemination strategy, the Ensemble Engine represents an opportunity for the potential of social physics to become much more broadly explored.

4.3.1 Introduction to Ensemble

The Ensemble Engine's most notable features are its flexibility, its domain-independance, and ease of use. The Ensemble Engine's design was informed through the experience of

[3]Primarily developed by myself, Aaron Reed and Paul Maddaloni, though clearly it would not have existed without the efforts of all who worked on the original CiF, with particular recognition for Josh McCoy, who eagerly brainstormed potential architectures during Ensemble's infancy. Development on Ensemble was overseen by Michael Mateas and Noah Wardrip-Fruin.

building CiF and utilizing it to create multiple games.

CiF was originally written in ActionScript3, and developed in conjunction with the game *Prom Week* [152, 153]. *Prom Week* is a successful example of AI-based game design [63], a paradigm in which an AI architecture and a game using that AI are developed in tandem to expand the expressive range of both systems. Chapter 5.3 will explore some specific ways in which *Prom Week* was successful; suffice it to say that *Prom Week*'s success spoke of the utility and flexibility afforded by social physics.

Heartened by this success, and inspired to overcome some of the system's design challenges, the drive to create the Ensemble Engine was born. The Ensemble Engine boasts a flexible action structure, expressive social rules which govern character behavior, and comes bundled with a powerful authoring interface. This new engine is the next iteration of CiF-style social physics, completely re-written from the ground up in JavaScript, currently the dominant language for web-based playable experiences. JavaScript was chosen to allow for rapid prototyping of ideas, flexibility in usage for projects, and its wide coverage of platforms, from PC to mobile.

And, as a brief aside, while the primary motivation for creating the Ensemble Engine is to aid the spread of social physics, a secondary motivation is to make a family of artificial intelligence techniques more broadly available to both independent game creators and game researchers. This included weaving Ensemble workshops into an introductory game design course to help inspire new generations of game designers. The Ensemble Engine approach to rule authoring and action nomination has the potential to make a variety of innovative game projects easier to create, and thus I have been striving to help them be explored as widely as possible.

4.3.2 Expressive Features

This section will cover several of the features that give the Ensemble Engine its ability to represent complex social worlds

The Ensemble Engine allows users to easily specify the categories of social state in the world via a schema. Once these categories are defined, users can reference them in social rules to govern the considerations of the entities that populate their playable experience.

Moreover, the rules of the Ensemble Engine are capable of describing and referencing complicated social situations involving any number of characters.

The Ensemble Engine also introduces a new structure for character actions. These actions take advantage of EE's enhanced rule structure and a character-to-role binding process for increased authoring flexibility.

The schema (see figure 4.2) is an easy way for users of the Ensemble Engine to define the categories of state in their system. Let us begin by describing how state is internally represented in EE (which should smack of familiarity of the way it was represented in CiF). This will be followed by an explanation of how the data-driven schema system of the Ensemble Engine can be tailored to the specifics of any given playable experience. Next, we'll detail the specifics that make up a category defined by a schema and the advantages schemas have over hard-coded alternatives. Finally, I'll discuss other ways that the Ensemble Engine and its users benefit from a data-driven approach.

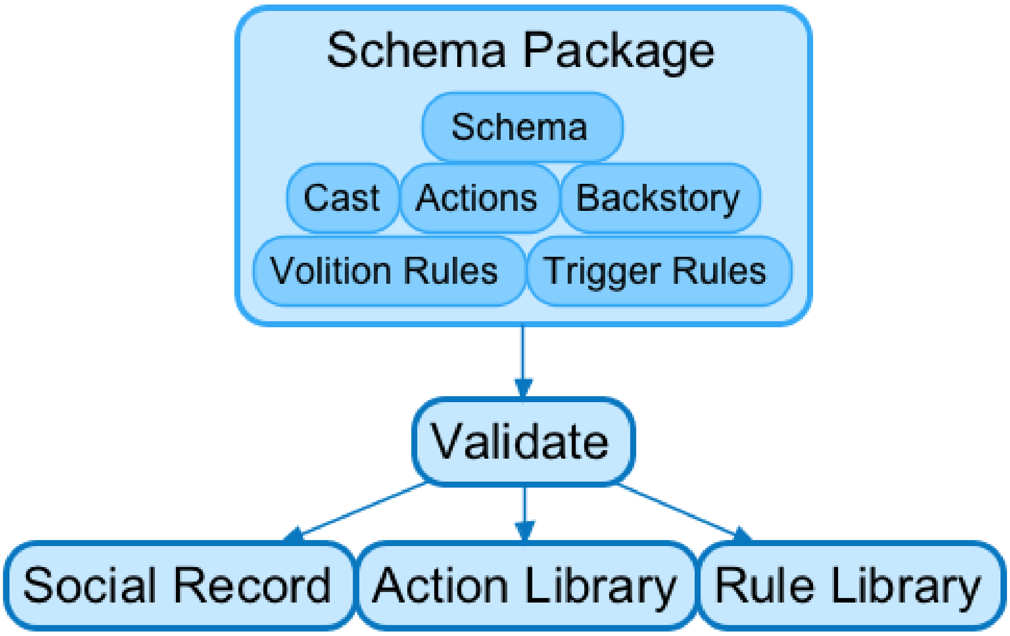

Figure 4.2: Data flow of schema package components. Social world authors create a schema package. After a validation process, elements of the schema package populate the initial state of the social record, and the action and rule libraries.

4.3.2.1 Categories in the Ensemble Engine

One of the primary responsibilities of the social engine is to track state. The truths of the diegetic world are stored in a Social Record (SR), the moral equivalent to CiF's social fact database, see 4.2.3.4. Some example SR records from *Prom Week* include character descriptors (e.g., Monica has the trait arrogant and the status popular), mutual relationships between two characters (e.g., Simon and Zack are friends), and non-reciprocal directed attitudes from one character to another (e.g., Gunter has an affinity of 87 for Phoebe).

In the original CiF, the categories of traits, statuses, and relationships could each be thought of as a category of social facts, and any given social fact of a category referred to a specific type within that category. Some trait types present in *Prom Week* include arrogant, jealous, brainy, attractive, strong, and clumsy. Some *Prom Week* status types include being popular, feeling sad, and feeling angry. The relationship types in *Prom Week* are friendship, enemies, and dating.

These categories were created in the service of *Prom Week*, though in retrospect there was some undesirable overlap between them. For example, traits were meant to be immutable facets of a character, whereas statuses represented more ephemeral states or moods, which would eventually fade away unless the source of the status persisted. Statuses were additionally broken into two distinct types of "directed" and "undirected," identical except in whether they referred to a status between two characters (such as being angry at someone) or a single character (such as feeling happy).

The distinctions between these three categories, which evolved during the design of a specific social physics based game, were a bit unclear. Though directed statuses, undirected statuses, and traits are three unique concepts, they shared certain properties, such as all referring to Boolean aspects of state. Common properties were noted among other categories as well (e.g., an affinity score from one character to another is in many ways a scalar version of a directed status). Realizations such as these led to the derivation of common properties between social facts such as *isBoolean* to distinguish between a fact referencing a boolean (e.g., traits and statuses) or a scalar (e.g., networks such as affinity). Similarly, there seemed to be three primary *directionTypes*: undirected (traits, statuses), directed (networks, directed statuses), and reciprocal (relationships).

Once these common properties (and others, see below in 4.3.2.2) were recognized, they became the basis for defining a social schema. In short, the Ensemble Engine's social categories are determined by these defining properties, rather than hard-coded and imposed by the system.

The properties of each category affect how the Ensemble Engine processes that category. The Ensemble Engine does not have a separate evaluation function for each category; it breaks functionality up by properties. For example, all code dealing with Booleans is defined in one place, as is all code dealing with reciprocity.

Thanks to this design choice, it became easier to describe the distinctions of different categories, and to mix and match properties to generate entirely new categories. The larger variety of categories enabled by doing this allows social physics to be applied to a wider variety of game genres. For example, it is now relatively simple to define a new category that describes numeric facts that only apply to an individual character. Individual numeric traits are part of many games, including most roleplaying games that might make use of numbers such as these to represent character attributes like strength, agility, and charisma.

The Ensemble Engine also uses a data-driven approach to allow for the easy editing of categories. Users can edit a JSON file called a schema, which contains all of the types for their playable experience. The Ensemble Engine then reads it in, and makes use of the contents of this file. The rules written by the user are validated, and it ensures that the types referenced in the rules are specified in the schema file, raising an error if there is a mismatch, and then directing the user to the file with the offending rule.

4.3.2.2 The Components of Categories in the Ensemble Engine

To give a sense of the range of categories that can be created in the Ensemble Engine, I present the properties that can be defined:

- **category:** A string representing the name of the category.
- **isBoolean:** If true, the category represents a Boolean fact. The category is a scalar if this is set to false.
- **directionType:** Can be "directed" (affects two or more entities, from one to others), "undirected" (applies to only one entity), or "reciprocal" (meaning that the category affects two entities, and will always be the same value between the two entities). If used in the spirit of the original CiF, these entities will most likely take the form of characters in the playable experience. If used outside of a social-based context, these entities could be anything that have a relation to each other, e.g. floors in a procedural dungeon generator, the properties of a texture, or the rules to a game itself. This ability allows the use of non-character elements of a game to act more dynamically and change based on rules provided to the Ensemble Engine. That said, since Ensemble was specifically inspired to be a social simulation system, please accept that I will be using the term characters to refer to both traditional agents as well as these more abstract entities.
- **types:** An array of strings representing the potential instances of the category (e.g., the "status" category might have types popular, sad, and happy).

- **defaultValue:** The initial value for each type applied to all characters at the start of a playable experience, unless otherwise specified. Should be true or false if isBoolean is true, or an integer otherwise.
- **duration** How many discrete time steps the category should remain true, if boolean. If unspecified, assumed to be infinite. Ensemble keeps track of time via these time steps, which are incremented when the client game chooses to do so.
- **minValue/maxValue:** The minimum and maximum value types of this category, if numeric.
- **actionable:** A boolean value specifying whether this category is permitted to be part of character intent formation. As CiF before it, one of the key components of the Ensemble Engine is calculating volitions (i.e., desires) of characters and determining the actions they want to take, in hopes of adjusting the current social state to fulfill these desires. Any category can potentially be the subject of intent formation if actionable is set to true. Though the terminology is steeped in social metaphor, intents are largely a means of categorizing actions, with the volition formation process acting to nominate an action for performance within one of these categories. Though the internal terminology feels best suited for a system with agents forming volitions, the Ensemble Engine works just as well for more abstract entities "taking actions" to change their qualities and their connections to other entities.

4.3.2.3 Benefits of the Ensemble Engine Category Structure

The new category structure of the Ensemble Engine is very flexible. In addition to being customizable—category names such as "relationships" and "statuses" can be named by the user to terms they find more appropriate—the system has significantly enhanced expressive power through the new combinations of categories now accessible by the Ensemble Engine.

Some of these new combinations, such as the aforementioned individual numeric traits, make the Ensemble Engine more compatible with existing game genres and conventions. Through experimentation, some interesting atypical combinations can be discovered. For example, a category with isBoolean set to true, a finite duration and a default value of true could represent a condition that will keep recurring unless characters actively work to prevent it from happening, such as in a social world where sickness is the norm and taking medication only temporarily alleviates it.

In short, users of the Ensemble Engine have the power to define novel categories that are pertinent to their playable experience.

4.3.2.4 Other Schemata Components

The schema file is only one part of the new data-driven approach employed by Ensemble. Other files allow Ensemble Engine users to specify information pertaining to the characters (or other entities) of the world (the cast), the starting history of the world (backstory between characters, or any starting state that differs from the default values specified in the schema file), the trigger and volition rules of the world (discussed in more

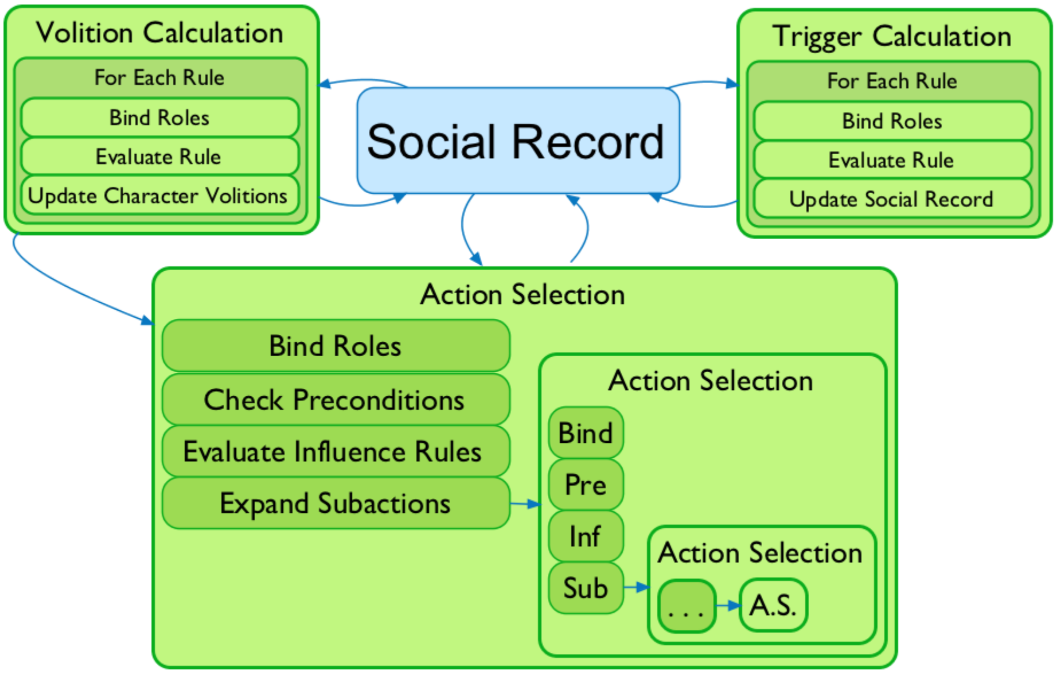

Figure 4.3: Three major processing elements of the Ensemble Engine

detail in 4.3.2.5), and the actions that the cast can take in the world (also discussed in 4.3.2.5). Please see figure 4.3 for an overview on how many of these components play off of each other.

4.3.2.5 Social Rules

In a world driven by a social engine, the cast-held considerations that govern intent formation are defined through rules. The lefthand side, or LHS, of rules is comprised of a collection of predicates, where each predicate asks a question pertaining to a single fact of the current state of the world. If all of the predicates of the LHS of the rule hold true, then the right-hand side (RHS) of the rule is valuated; that is, the social state is updated according to the predicates of the RHS; the nature of the update is dependent on the type of rule being evaluated. Ensemble rules broadly fall into one of two types: volition rules and trigger rules, both with different content in the RHS. Volition rules will either add to or detract from a cast member's desire to perform certain types of actions. Trigger rules will directly change the state of the world by adding records to or removing records from the SR if the LHS of the trigger rule is met. This is the general functionality of rules from the original CiF (see chapter 4.2.3.5), and this structure has not changed much for EE.

What has changed, however, is the binding process of roles in rules. Any given predicate in a rule involves at most two roles, a first and a second. If the predicate in question describes a fact from an undirected category, then only first will be filled in, and the second will be blank (because the predicate only pertains to a single person). Otherwise the predicate will involve both a first and a second character.

It should be noted that even though any given predicate can involve at most two people, rules could involve more than two people through a combination of predicates. Take for example a social-engine-based representation of the classic adage, "the enemy of my enemy is my friend." One could represent the LHS of this volition rule using three predicates:

X and Y are not enemies.

X and Z are enemies.

Y and Z are enemies.

All three of these predicates involve two roles, but the rule as a whole involves three roles, X, Y, and Z. Of these three roles, X and Y both dislike Z while not having any particularly notable disdain for each other. One can imagine the RHS of this rule would increase X's volition to befriend Y.

The Ensemble Engine allows for any number of roles to be defined within a rule. For example, EE could verify if a character had been the butt of 4 or more practical jokes, or if that character had made a romantic proposition to 4 or more love interests, while simultaneously retrieving the names of the jokers or the lovers. Moreover, it could place additional constraints on the search for these characters (e.g., find four practical jokers who have the trait regretful, or potential love interests who already have the dating relationship with someone else). These refined rules can cover many nuanced situations that authors might like to affect character behavior and volition formation, and is capable of capturing queries unanswerable from CiF's num-times-true mode of predicate evaluation (see 4.2.3.5).

To illustrate characters reasoning about nuanced situations, let me use as example the situation where:

X and Y used to be dating.

Z and Q used to be dating.

X and Q are now dating.

Y and Z are now dating.

Here, X and Z (or Y and Q, depending on whose perspective you take) have essentially switched romantic partners. One can imagine that if this scenario were ever to arise in real life, it would affect the way that all parties involved view each other. In CiF, authoring this situation would have been less convenient as it would have to be captured in more than a single rule. These additional rules would apply intermediate statuses on the characters, serving as a faux binding process. These statuses could then be reasoned over in even more additional rules. Thus, while not strictly impossible with CiF, the Ensemble Engine's rules can scale with more than three roles, making it much easier for authors to write for.

One final note on the improvement of rules: though the authors have been using X, Y, and Z as a shorthand for proper role names in this paper, any string can be used. As long as the string is consistently spelled across the predicates of a rule, the Ensemble Engine will recognize it to be referring to the same role. Although this may seem like a small change, it is a quality of life improvement for content authors, making rules more human-readable during the editing process. Since rule editing occupies much of a social engine author's time, small improvements such as this can lead to an eased development process through prolonged use.

4.3.2.6 Flexible Action Structure

After forming volitions based on the current social state, each character (the initiator) determines how they wish to affect the world by engaging in a social exchange with another character (the responder). Like the social exchanges of CiF they were based on (see chapter 4.2.3.3), actions are tied to a specific intent. These intents were discussed above the overview of the schemata in 4.3.2.2. The Ensemble Engine has a hierarchy for actions: Intents in the Ensemble Engine may now be followed by one or more actions, each of which in turn can point to additional actions. Actions in the Ensemble Engine are defined in a JSON file with the following components:

- **Name:** A string representing the name of the action.
- **Conditions:** An array of predicates representing hard preconditions that must hold true for this action to be considered. Using a similar binding process to the one described in the previous section, a record of all potential candidates for each role in the conditions is kept. If there is no valid binding, the preconditions do not hold, and the action is deemed impossible for this particular initiator and responder at the given time step.
- **Influence Rules:** Identical in structure to the volition rules discussed above, they take an entity's base volition score (or desire to engage in the action, computed via intent formation), and add or subtract from that score to modify the entity's volition for this particular action. Influence rules tied to actions serve two functions. First, they help determine which action within a single intent a character might be more inclined to perform (e.g., a brash character might prefer to StartDating through a Pick-Up Line, while a reserved one might opt to simply Ask Out). Second, they help determine the best candidates for any non-initiator and nonresponder characters specified in the conditions. That is, the conditions state the required qualities any tertiary characters have, whereas the influence rules describe their preferred characteristics.

- **leadsTo:** An array of action names. If all of the conditions hold for the current action, then the Ensemble Engine will evaluate each of the actions in the leadsTo array. The starting score of each of these actions is the ending score of the current action determined by evaluating its influence rules.

- **isAccept:** Actions are categorized as "accepted" or "rejected" when the responder character receives the intent of the social game positively or negatively, respectively. This Boolean value specifies whether this is an action that should be played when the responder accepts (true) or rejects (false). Though this concept was originally implemented in CiF to solve a design problem in *Prom Week* (namely, the readability of the results of a social exchange), its utility generalizes to other games.

- **Effects:** An array of predicates specifying how carrying out the action should affect the state of the world. Both the initiator and responder can be referenced here, as well as any additional characters bound to roles specified in conditions and influence rules.

This new structure for actions allows for functionality that was difficult to implement in CiF. One marked improvement is that this new system allows actions that refer to more than two people. Players of *Prom Week* may recall that some social exchanges did involve three characters, but the third character was chosen in a manner that was largely outside of authors' (and entirely outside of players') control. Now, thanks to influence rules being able to adjust volitions for not only the initiator and responder, but other characters as well, Ensemble Engine authors can create actions that focus on three or more characters.

One such action that the *Prom Week* authors always wanted to implement but never could without making severe concessions was Spread Rumors. As originally envisioned, the player would select an initiator, a responder, and a victim to be the target of the rumors. The list of potential victims would be filtered to only candidates that made sense given their relationship to the initiator and responder. This proved impossible given CiF's architecture, and was ultimately implemented in the same way as all other social exchanges in *Prom Week*: players selected an initiator and a responder, and the system selected a third party that simply satisfied hard preconditions. Although this provided a modicum of control for authors, the difference between a boolean restriction and adjusting a weighted volition has serious consequences for an author's ability to fine-tune social behavior. For instance, if the initiator's friend just made a pass at their date, then perhaps the initiator would want to damage the reputation of their so-called friend. This social situation is now possible with EE.

Another exciting possibility of this new structure is hierarchical actions. Authors can define an action structure as simple or complex as they require, and easily divide up specific actions more elaborately than others, if more authorial control is needed, simply by changing a terminal into a nonterminal, which leads to more granulated, sequential actions. This structure also gives authors more information about the path taken to reach a certain terminal. That is to say, users need not only look at the terminal action (i.e., the deepest action in the hierarchy where all preconditions are true), but can instead incorporate the entire lineage of actions that led to that terminal. Through the use of this lineage, additional context can be gleaned that might affect the performance of the action, or the effects the action has on the state of the world, or both. Since a single action can have multiple parents (i.e., multiple actions that include the action as a child), there is the potential for myriad variations on any action given the hierarchy chain that led to it.

Currently the native support to leverage the power of hierarchical actions of the Ensemble Engine is limited to providing the chain of actions that led to a terminal action. Taking advantage of the new action structure will make the Ensemble Engine capable of expressing even more varieties of actions, and is exciting future work.

4.3.3 New Authoring Tool

A new authoring tool has been created alongside the development of the Ensemble Engine incorporating several design insights discovered through the use of the authoring tool created for *Prom Week*.

4.3.3.1 The Features of the Tool

When the tool is first opened, the user is prompted to select a folder that holds a social schema file and associated data (i.e., a cast of characters, pre-defined history, trigger and volition rules, etc.). This data populates the various features of the tool. The authoring tool is split into four major components: a debug console, an SR History Viewer, a rule viewer for volition and trigger rules, and a rule editor.

The *debug console* simulates a traditional command prompt, and recognizes a handful of special commands for querying and changing the state of the rule system. These commands include adding and removing records from the Social Record, seeing the volitions of all of the characters given the current social state, and having characters carry out actions, as well as adding their consequent effects to the social record.

This enables users to quickly set up social situations and verify that the system is behaving as intended, and was inspired directly from the difficulties of authoring in *Prom Week*. This was most apparent when testing specific edge cases of social state involved the time-consuming steps of either recreating the situation through game play, or setting up the perfect social state by editing (and rebuilding) the external library of authored content. Including this debugging functionality in the console encourages a more rapid cycle of discovering problems, and iterating on rule design, as well as fixing bugs in the system itself.

Any social changes, either through console commands or as a result of character actions, are added to the *Social Record History viewer*, along with any records specified in the loaded history file. The history viewer shows the user what the social state of the world was at any given point in history, allowing them to observe each time step of the system. At each time step, the social facts added that turn are highlighted in green, so the user can pinpoint the specific moment a change occurred.

As a social world becomes full of trigger rules and complex actions, it can be difficult to keep a holistic view of the system in one's head. The history viewer assists the user in pinpointing the time step when an undesired social change occurred. This assists in

Figure 4.4: The Rule Viewer, showing a filterable list of the volition rules authored in the loaded schema package. Clicking a rule will open it in the rule editor.

the discovery of the causal rule or action.

The *rule viewer* (see Figure 4.4) provides an overview of all rules written for the system, showing trigger and volition rules in two separate tabs. Each rule is summarized with its hand-authored name (a simple string meant to describe the essence of what the rule is capturing), as well as a generated natural language description of the predicates composing the rule. This lets the user see a large number of rules at a glance. If the user hovers their mouse over a rule, a tooltip with the original predicate object appears. If a rule is clicked on, the rule will open in the rule editor described below.

The *rule editor* (see figure 4.5) allows one to edit existing rules in the system, or create new ones. As previously discussed, rules consist of a descriptive name, a LHS of predicates representing the conditions that must hold for the rule to fire, and a RHS of predicates describing what changes should transpire if the LHS evaluates to true. The editor is designed to make authoring predicates simpler, and to enforce correctness in their structure and content.

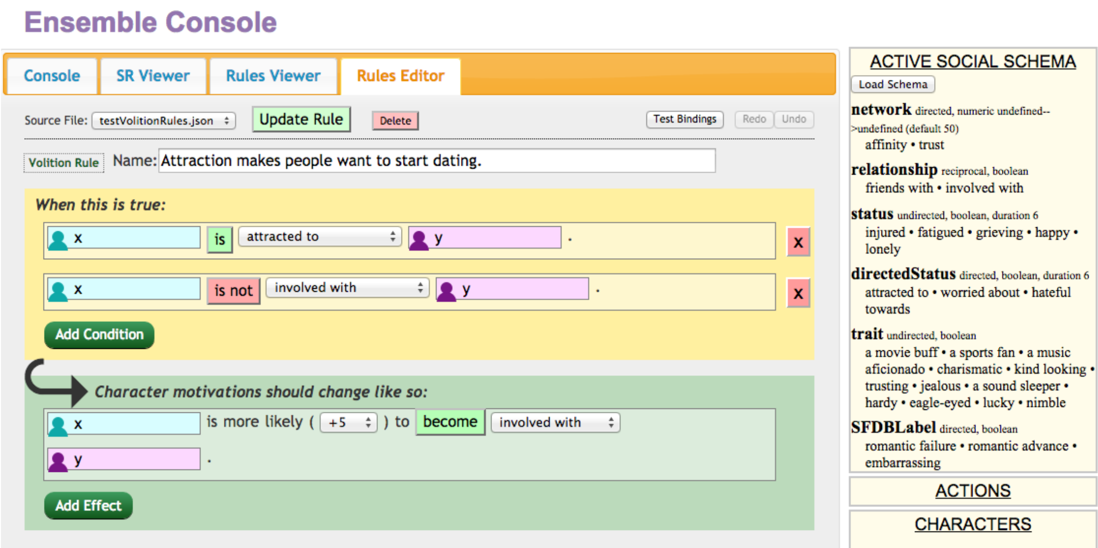

Figure 4.5: The Rule Editor, showing a dynamically constructed predicate editor for a volition rule.

4.3.4 Some Closing Thoughts on Ensemble

Dynamic and nuanced social relationships are an integral part of many game stories, as evinced by some of the most popular games on the market. Unfortunately, most games fall short in making this vital aspect of these experiences playable, basing social game progress on prewritten branches or binary quest completion rather than exploring procedurally driven social relationships. One potential reason for this is the lack of "off the shelf" social AI systems available for game developers to pick up and plug in to their games. The Ensemble Engine is a potential candidate for fulfilling this role, being for social AI what Box2d [32], Havok [97], and many others are for Newtonian physics.

EE improves upon its predecessor in a variety of ways, including more expressive rules, more flexible actions, and a user-friendly authoring tool that doubles as an Ensemble Engine debugger. Although the Ensemble Engine has already made marked improvements, there is still more work to be done. While some aspects of a social state (such as rules) can be created entirely within the editor, presently the only way to author elements like actions is by hand-editing JSON files. At the time of this writing, the authoring tool is being enhanced to eliminate this awkward step. Once the authoring tool can communicate with playable Ensemble Engine experiences, a new degree of powerful real-time debugging will be made possible. Extending the tool to take advantage of this capability will require hands-on experience designing and iterating new experiences. To increase ease of integration into existing game design paradigms, translating the Ensemble Engine into additional languages seems an important step; a C# version is particularly appealing for easy integration with the Unity [304] game engine.

In addition to improving the Ensemble Engine itself, and in the spirit of shared authorship, it would be wonderful to create a website and community for Ensemble Engine authors. This community would provide a space to showcase work, lend helping hands, and share influence rules and actions with other authors. Much like 3D modelers can currently browse databases of user-created objects, a community where two authors working on "office comedy" stories could discover and share sets of relevant social rules with each other seems like a valuable and powerful way to nurture the adoption of social physics.

It is my hope see an influx of new digital games with novel mechanics based on social relationships at their core. Clearly I believe that the Ensemble Engine is a step towards achieving that goal. But that, in and of itself, is not quite the same as a new technology that enables new works of shared authorship. Now that I have thoroughly discussed two social physics engines, let us take a moment to discuss both the ways that social physics lends itself beautifully to the cause of shared authorship, and the ways in which the technology and the ideals clash.

4.4 Social Physics and Shared Authorship

To begin this conversation, let us first recognize that there are many different points at which "authorship" transpires in a social physics system. There is the "CiF author" or "Ensemble author" (henceforth referred to as the social physics author) who is in charge of penning social exchanges (or actions), influence rules, instantiations, character backstories, the cultural knowledge base, and microtheories. There is the player, who is authoring their own game play trace. And lastly, there is the system itself, which computes the character's volitions, determines appropriate social exchanges, and selects salient instantiations. There is also a meta notion of "social physics author" referring to the creators of CiF itself (myself and my dear friends and colleagues in the Expressive Intelligence Studio), but for this discussion I will not be considering that particular set of authors.

Returning to the three defined authorial roles, is it "fair" to separate the social physics authors from the system itself? Seeing as how these are deterministic systems, is it not the case that the system is simply only doing exactly what the social physics instructed it to do? Perhaps referring to the system itself as its own author is a little bit of a misnomer, but I do firmly believe that the social physics authors themselves cannot be considered the sole non-player authorial force in the mix. As will be discussed in the next section, the social physics system itself—and not the direct authorial control of the system's designers—play a significant role in several of the previously defined axes.

4.4.1 The Simulative Authoring Layer: Collaborating with a Simulation

In social physics based experiences, the social physics author does not directly author the course of the narrative. Every artistic choice they take shapes the narrative possibilities of the experience—influence rules will dictate how characters will want to behave, social exchanges and actions determine how characters have the capacity to shape their world, instantiations determine how impacts to the social world are presented to the player—but they have little to no direct authorial control over the types of stories that are being created. Already we see social physics engines enabling high scores along certain dimensions as outlined in 3.2, namely the level of simulation and the number of distinct reachable states.

Let us just take a moment to appreciate how this is a fundamentally different approach to most of the playable experiences I have discussed up to this point. Most games do have a story (or a small span of a few stories) that they are trying to tell,[4] and the player is consuming it. Social physics lends itself best to situations in which the narrative is undetermined at runtime.

[4]Now, I do want to make clear that I am not attempting to say that social physics based games are "not about anything." To the contrary, it is relatively simple for social physics authors to provide commentary and critique on social dynamics in the real world by operationalizing them inside of systems such as CiF and Ensemble. Even still, though the story may be "about" something as determined by the social physics author, the narrative itself is largely undetermined

This is in part due to the fact that it takes quite a bit of authoring effort to get characters to start showing signs of believable social behavior. Even in a token, toy world, with relatively few social considerations, it can take a massive amount of authoring effort of social rules before characters start to appear to "care" about the social norms of their society. If one is hoping to author a world with relatively few social considerations, then perhaps a system such as *Mass Effect*'s paragon and renegade system [17] would be more appropriate; though keeping track of triggered events based on flags and numeric values can potentially lead to authoring mistakes, it is comparatively much more straightforward than authoring a pool of social considerations.

As opposed to brittle flags and script triggers, social physics systems allows for a much more robust system in which every rule authored is contributing towards a cohesive whole. As players begin to explore social physics based games, they ultimately, ideally, grow an image of the underlying rule system in their heads. Whether the player chooses to interpret this as the will of the characters, or rather the machinations of the system, to some extent makes no difference, as either framing still firmly paints the relationship as one of collaboration. That is to say, either the player is collaborating with the system to tell a story, or the player is treating each of the characters powered by the system as collaborators. Players will presumably be playing with some purpose in mind (either that is working towards a specific goal laid out by the playable experience, or simply experimenting with different social exchanges and actions to see how the characters will behave), and the characters powered by social physics will in turn be behaving according to the social norms that they've been "brought up" to adhere to from the social physics authors. Thus, both the player and the characters are working together to massage the social state to something that is mutually desired; making characters driven by social physics engines appear somewhat human-like in nature (the exact degree largely determined by the framing determined by the playable experience making use of social physics, and the nature of the rules written for the system).

As was discussed in the preceding summaries of CiF and Ensemble, social relationships are at the heart of many stories; thus systems which enable malleable, playable social relationships are incredibly important to the cause of shared authorship if for no other reason than the nature of stories that can be to told with such a system. Moreover, one of the joys of collaborative authoring—and one of the aforementioned pleasures of shared authorship—is navigating one's relationship with one's co-author; social physics systems can be applied not only to the characters in a story, but to a representation of the system itself.

But perhaps the greatest boon that social physics systems allow for is a dynamic, believable, consistent, *emergent* narrative. That is, a narrative which naturally emerges from the player's interactions with the system, and the rules that govern it. Neither player nor system may have a firm narrative in mind at beginning of play, but through continuously "sharing ideas" with each other—the player proposing ideas by affecting the social state, the system responding with the social fall out the player's actions had on the world—the player and system slowly build up a story out of nothing. In this sense, playing with a social physics system is somewhat akin to playing with a scene partner in improvisational theatre (see chapter 2.2.3); the story is slowly being built, piece by piece. Crucially, this is emergent narrative that the system itself is capable of reading, and uses its understanding of what has transpired thus far in its processes for determining what could happen next. Experiences making use of social physics systems, then, will tend to score very highly on the axis referring to the number of distinct play traces, and activate the pleasures of making one's own narrative, crafting their own path through the narrative[5].

Though social physics games might be criticized for being too "in the moment"—a Skinner box of sorts where characters are reacting and behaving based on their current circumstances—this is in some regards the exact zen-like state of being that many improvisers strive for: to not be thinking about the grander narrative and to instead be fully committed to living truthfully and genuinely in each given moment. I also happen to feel that the Skinner box comparison is not entirely fair, as the character's "in the moment" considerations also take into account an entire history of past actions, but I digress. The criticism remains that social physics systems on their own are unlikely to lead to convergence in narrative; though a causal chain is forged from action to action, there is no guarantee that they are building towards a satisfying whole that perfectly weaves together everything that has come before. As such, social physics systems on their own will likely score low on the convergence dimension.

Before moving on to other criticisms and shortcomings of social physics as a piece of shared authorship, a quick closing note about the above: it is dangerous to make sweeping statements about the nature of social physics systems because in the grand

[5] I will go into more explicit detail about this in my review of *Prom Week* in chapter 5.3.

scheme of things they have only been applied to a relatively small number of systems at the time of this writing. Though I am attempting to be as broad minded as I can be, I am undoubtedly being affected by the actual pieces that have been built with them thus far.

4.4.2 Social Simulation and Shared Authorship Difficulties

Although I clearly think that social physics is a powerful mechanism to achieve shared authorship, the systems described above have design decisions, and absent features, that could be considered to hinder the cause. These points are raised not to disparage social physics (to the contrary, I wish to laud them night and day), but rather to point towards potential enhancements that could be made towards these or future systems that might yet bring us even more fulfilling works of shared authorship.

To start, as mentioned above, it takes many social rules before characters start to exhibit signs of panoramic social awareness; prior to that threshold one can achieve similar levels of expressivity through less time intensive means. It also adds to the difficulties for social physics authors to successfully test and debug that agents in the world will continue to behave believably given changes in rules (this will be discussed in more detail in section 5.3); changing, adding, or removing rules to the pool might make certain character actions more believable, but could have unintended side effects. These side effects might include characters no longer wishing to engage in particular actions that were sensible, or beginning to want to engage in actions that are not sensible[6]. This

[6] I'm using the word "sensible" here as short-hand for the readability from a player's standpoint; the characters, of course, are obediently following all of the social norms of the world. As I'll discuss shortly,

is the unfortunate side effect of rule based systems such as the social physics engines described here; the fact that each rule seamlessly integrates and cooperates with each other is a blessing that leads to emergent behavior, but that emergent behavior can potentially be undesirable from a social physics author standpoint.

Now, the idea exists (laid out in [290]) that just because a system is capable of generating narratives (or social exchanges, or actions, etc.) that the system designer does not want, does not mean that the generator is necessarily at fault; instead it could indicate limited thinking on the part of the system designer, refusing to successfully collaborate with their narrative partner. This is, of course, a form of shared authorship; though the shared authorship that I have been exploring is that between player and system/system designer. Thus, given that social physics makes it difficult for social physics authors to be able to perceive potentially problematic rules, let alone address them, to successfully author the space of stories they hope the player and system to generate together, is a valid concern. To be able to evaluate whether a social physics system is capable of producing stories the social physics authors are happy with, novel evaluation techniques will need to be employed. I'll discuss some of these techniques in chapter 6.

Perhaps a bigger problem regarding rule interpretability is that it can sometimes be difficult for the players to successfully understand the thinking and decision making of the characters. This is a serious problem; both for shared authorship and for the enjoyment of social physics based games as a whole. One of the chief claims of these

the readability of these social norms can sometimes be difficult for players.

social physics systems is that it provides characters a deep social intelligence (or, at the very least, that they will behave believably given their current social circumstances). However, if characters are considering too many things, or if the social rules encoded do not clearly jive with the social rules the player has conceived of (which can easily happen if, say, the player and social physics authors come from different cultures), then their behavior might appear to the player as random. This is the opposite of the pleasure of shared authorship in which one gets to know their collaborative partner, and is a variation of the previously described Tale-Spin effect: virtual agents fail to communicate the sophistication of their algorithms, thus appearing like they are hardly "thinking" at all. This is not to say that this is a trait of all social physics systems, but it is definitely something that was often observed while playtesting CiF playable experiences.

I have yet to discover the perfect solution to this, though it seems that, in part, the answer lies with exposing the inner workings of the system so that players can see the depths to which the social physics engine is operating. In a sense, creating experiences that specifically attempt to score higher on the visibility of story variables axis as a means to allow players to better understand the system's "creative process" i.e., how it moves story values around based on the player's influence. This, of course, runs a separate risk of overwhelming the player with too much information. Moreover, with so many moving parts, even with story values exposed, there are likely multiple factors influencing any given outcome which might be difficult for players to track. Regardless, it does appear that finding ways to tactfully break immersion in social physics systems to reveal the underlying processes is an important ingredient for allowing players to both deepen their understanding of their partner, and for their enjoyment of the game as a whole.

Another point worth mentioning is that just as the player might have a difficult time gaining an understanding of the system, the system itself—at least of the two described above—is not endeavoring to learn the predilections of the player. The systems allow for a large amount of dynamism, adapting character desires and behaviors substantially based on player input, but beyond character volition being in part determined by accumulated history, neither system is at any point attempting to learn the type of story the player is hoping to tell. The drama manager systems I discussed in 2.1.7 were able to perceive the actions of the player and attempt to funnel the game content to make those actions meaningful. I also covered player modelers in chapter 2.1.8 that attempted to shape the experience based on the perceived preferences or expertise level of the player. Now, it is of course alright that social physics is not a swiss army knife capable of providing all of these services on its own. However, since the ability to adapt to one's collaborator over time is one of my aforementioned pleasures, integrating social physics with a technology that is capable of doing so seems very important for pieces of shared authorship.

This leads to another unfortunate truth: as of this writing, there have been few examples of integrating social physics with other technologies. Most games made with these systems thus far have had social physics be the center point of the experience; a notable exception to this is the IMMERSE project, though that did not use CiF directly, but rather took inspiration from CiF and integrated social physics metaphors into a new version of the ABL reactive planner [143] used to power the characters in real time. Chapter 8 details a work in progress that utilizes Ensemble alongside another technology in the service of shared authorship. This provides a little bit of hope that more such pieces could be developed; which is heartening, considering that all of the technologies described in chapter 2.1 had relevance to the cause of shared authorship.

I mentioned above the potential criticism that characters represented by social physics engines might feel a little bit like a creature stuck in a Skinner box, only capable of responding to its immediate stimuli. Although the characters' consideration of the social history of the world helps refute that critique, it is true that neither CiF nor Ensemble have mechanisms to provide for characters to form long term plans and desires. Thus, though they may take into account many social, cultural, and historical factors in determining how to behave around each other, they will not form long-term plans to achieve desires. This does tend to yield short term behavior. With careful authoring effort, however, this can be masked a little. For example, if a character hopes to date someone already in a relationship they might be inclined to spread rumors about their crushes' current partner; this however does not come from a place of believing that spreading rumors could lead to the two breaking up which in turn boosts their chances to snag a new lover, but rather from jealousy that this person has a special relationship that they would like to have themselves. There can, of course, be myriad conflicting forces at play here (e.g., they might not want to hurt their crush by spreading rumors), but the action is not made with the thought of making short term moves to achieve longer term goals. Pairing a social physics engine with a narrative planner (see chapter 2.1.6) could potentially leverage the powerful reasoning characters engage in for not just the present, but the future as well.

It is also interesting to connect social physics to the notion of the reliable collaborator (see 3.2). In both CiF and Ensemble, the characters are by default extraordinarily reliable, possessing perfect knowledge of the social state, and using that to inform their decisions. This is an extreme case of a reliable narrator; an authorial force with such omniscience that it actually hurts character believability. As discussed in 4.2.4.1, there have been experiments with attempting to incorporate a model of theory of mind, but these changes were specific for *Mismanor*. Having imperfect information integrated into a social physics system would both expand the types of stories capable of being authored, as well as more accurately simulate the joys of working with a collaborator who, under typical circumstances, would not have perfect information about every artistic decision made by their co-author.

4.5 Conclusion

We have now drunk deep from the cup of social physics. Hopefully, after thoroughly discussing two separate social physics engines, it is clear to see that a system which affords dynamic character relationships and complex character volition calculation can be a useful tool towards achieving pieces of shared authorship.

I have discussed the systems themselves in great length, and mentioned in passing a few of the playable experiences they have been integrated within. However, in order to gain a fuller understanding of the affordances of social physics, there can be no substitute for an exploration of a playable experience in which gameplay entirely revolves around engagement with the social physics system. And thus, I'll begin my discussion of a game rife with Machiavellian social maneuvering, high emotions, higher stakes, and rented tuxedos. Gentle reader, it's time to talk about *Prom Week*.

Chapter 5

Prom Week

5.1 Introduction to Prom Week

The primary application of CiF in a playable experience is the social simulation game *Prom Week*[1], which was released on February 14, 2012. Links to play the game for free can be found at https://promweek.soe.ucsc.edu/play/. This chapter describes how *Prom Week* made use of CiF to enable a narrative social puzzle game with rich characters and social physics[2]. Just as existing traditional physics puzzles rely on the player's intuitive understandings of physical forces such as gravity, momentum, and inertia, the social puzzle leverages the player's inherent knowledge of how people behave in a variety of social situations. In the delicate system of social physics, the smallest social change

[1] *Prom Week* came into existence through the tireless efforts of a bevy of incredible individuals. The core team was comprised of myself, Josh McCoy, Mike Treanor, and Aaron Reed, with oversight and guidance provided by Michael Mateas and Noah Wardrip-Fruin. That said, recognition and appreciation must be given to Brandon Tearse and Teale Fristoe, Jacob Pernell, Ryan Andonian, Corey DiMeceli, Christian Ress, Melissa Bernetsky, Devon Wyland, Travis Brown, Alexander Schneider, Zane Mariano, Duncan Bowsman, Garin Kessler, Alexander Baker, Daniel Cetina, Lauren Scott, Kathleen Kralowec, Ellen Otsuka, Evan Mertz, and Alexei Othenin-Girard.

[2] And draws upon text from prior publications, including [160], [156], [154], [161], and [151].

Figure 5.1: A screenshot of one of *Prom Week*'s opening levels. Players click on pairs of characters to see what social exchanges they would like to take towards one another.

reverberates and impacts the entire system leading to emergent solutions and surprising, yet satisfying, outcomes. After my thorough investigation of social physics in Chapter 4, let us now explore how *Prom Week* utilizes social physics to achieve rich character specificity while maintaining a highly dynamic story space.

5.2 *Prom Week* Description

Gameplay in *Prom Week* revolves around the social lives of 18 characters at a high school in the week before their senior dance (see figure 5.1 to see a portion of the game's cast). Inspired by classic high school movies from the past few decades, the game parodies the intense social jockeying and emotional rollercoasters of a memorable week for many

Figure 5.2: A screenshot of the *Prom Week* interface. Oswald has been selected as the initiator, and Doug is the responder. The far left thought bubble contains all of the social exchanges Oswald wants to do with Doug, the product of volition formation reasoning over the current social state.

new graduates. In any given *story*, or *campaign*, the player is given a set of goals to potentially complete during the week leading up to the prom. For example, in Zack's story, one goal is to get him a prom date. Goals can be satisfied through an open-ended set of solutions discovered through interaction with the characters and social state. For example, the player could have Zack form a friendship with a popular character over a shared interest, or exploit another character's trait of "competitive" to make an enemy when Zack flirts with someone the competitive character has a crush on. Note that, while goals usually pertain to specific characters, players take on the role of an external observer and manipulator who can select which social actions all characters take.

The player works toward goals by choosing social exchanges for each character to

Figure 5.3: After the player selected for Oswald to "Bully" Doug, an instantiation is selected (and plays out) in which Oswald draws on past social history to make fun of Doug for an action he did in the game's backstory.

initiate; see Figure 5.2 for an example of the interface. Social exchanges are inspired by the notion of the social game, or "multi-character social interactions whose function is to modify the social state existing within and across the participants" [150]; an application and evolution of their definition coined during the development of *Façade* [144]. *Prom Week*'s social exchanges are designed to encode normal patterns of social behavior while providing space for personality-specific character behavior in a format that an AI system can make use of. The player chooses from the top social exchanges that each character desires to play with each other character. CiF provides this ordered list based on the outcome of the volition formation process, which in turn is informed by the social context of every character. Once a social exchange is selected, a short scene between the characters plays out—with dialogue informed by their social context (see figure 5.3)—and the social state is updated.

Because the gameplay of *Prom Week* involves manipulating the social space, which is the primary story content of the kind of high school narrative my colleagues and I hoped to emulate, the gameplay is the story. Every action the player takes advances the game's narrative and sends ripples throughout the internal social state, which in turn affects which actions are available in subsequent turns. CiF is a partner of the player, giving the gameplay narrative meaning and shape. This is in contrast to a sandbox game in which gameplay may be the story, but the story is formed only in the mind of the player, and not understood or reasoned over by the system. While CiF-enabled stories are authored in the sense that the designers create the initial situation, define the goals for each scenario, create the microtheories, social exchanges and instantiations, it is CiF that enables emergent solutions to each social puzzle, making the resulting story space highly dynamic and responsive to player action.

What follows are descriptions of *Prom Week* specific features, as well as *Prom Week*'s particular implementations of the CiF constructs outlined in Chapter 4.2.

5.2.1 Stories

When the player interprets the events in a complicated system as a narrative, an intensely rewarding and engaging experience can result [28, 75]. Many games such as The *Elder Scrolls V: Skyrim* [282] feature narratively charged open worlds with a great degree of player freedom and many possible emergent stories. However, these games can only rarely react in meaningful ways to the emotional or social consequences of player decisions. This is because, as I first discussed in 1.1.1 in my examination of *The Secret of Monkey Island* and have revisited many times since, these dimensions of narrative are usually not simulated by these games. The player can make their own interpretations about these dimensions but the system is unable to represent or reason over this crucial part of a compelling narrative. The social and emotional world is invisible to the game system. As discussed in my introduction of social physics engines in chapter 4, if one could capture the enjoyable aspects of player-driven narratives while still keeping the complex dynamism of sandbox games, one could enable a new type of game experience that is both deeply responsive to player choice and also personally meaningful. *Prom Week* was my first playable experience I developed that attempted to pursue these two ideals.

A player of *Prom Week* begins by selecting a story (also referred to as a campaign). A story is a collection of levels, each representing a specific time and place in the week before the prom, where the player can take social actions involving a particular subset of the characters in the story. Each story focuses on the social goals of a specific

Figure 5.4: Doug's social goals for his campaign, encoded in the same rule system that drives character volitions.

character; the goal of getting Zack a date in his story has already been discussed; other example goals in the Zack story include ending Zack's war against a bully, or getting Zack into a relationship with someone with the status "popular." Goals in a story are sometimes designed to be complementary: ending a rivalry with a "popular" bully could improve Zack's relations with the "popular" crowd, which could help his other goals. Sometimes they are designed to be in direct opposition: a goal of making several friends is mutually exclusive with a goal of making a clean break from high school and ending every friendship. As mentioned above, objectives can be met in a variety of ways: the player could forge a friendship between Zack and the bully, or perhaps make the bully lose his social standing, which might change his antagonism toward Zack.

Story goals (see figure 5.4) are a good example of external rules, mentioned in 4.2.3.5. They are *Prom Week* specific, but reason over elements of CiF's social state. After every social exchange, *Prom Week* uses CiF's rule evaluation system to check to see if any of the story goals have become true (or, if any that used to be true have become false). If there has been a change, then *Prom Week* lets the player know that story goal progress has been made or lost.

Every story's last level takes place at the prom. After the player runs out of turns, or decides to skip to the end of the night, a customized ending is presented that reflects the combination of goals achieved. For example, Zack's story might happily end with him becoming the prom king if the player was able to get him to date a popular person. Or, if the player had him abandon his unpopular friends to reach this goal, he might get a bittersweet ending where he still becomes prom king, but is confronted by his old friends. Every story has many possible endings for various combinations of goals the player might have completed. As the player finds more endings, additional stories are unlocked.

Designing *Prom Week* around CiF has resulted in unique opportunities for innovation in story and difficulty progression design. The game's puzzle-based nature could easily have conflicted with the desire to create a space in which the player has the ability to craft their own satisfying stories; having specific goals for the user can help direct their play, but there is also an inherent value judgment in the notion of a goal; failing to achieve a goal typically denotes a failing of some kind. My colleagues and I iterated on the structure of levels and goals many times in hopes of capturing the sense of direction goal-based play provides, while still honoring and valuing any stories the player wished to tell.

Originally, each level had its own set of goals that could potentially be failed by not completing them within a given number of turns. Even then, me and my fellow designers didn't want to invalidate the story that the player had been building by making him or her have to replay the "failed" level from the beginning with its initial starting state. We initially experimented with allowing the player to choose between erasing the social state changes and replay a level from the beginning, or retain the current state and continue to the Story's next level. Though the levels were designed to build upon each other, because of the many emergent solutions to goals, not meeting an earlier objective did not necessarily mean that a player had no chance of completing a later level's objective. However, we found that this limited our design space for future levels, as we attempted to author situations in which any given level's goals were achievable regardless of the player's actions in prior levels; this led to levels in which characters would rarely be affected by the player's previous actions, bringing us right back to issues of invalidating their agency.

In the end, level specific goals were replaced with campaign-wide goals. This retained goal-oriented game-play, but it allowed players to choose how they spent their time in each level and craft their own stories with no connotations of failure. It also made it easier to design campaigns in which players' actions in early levels would be valued and referenced throughout.

5.2.2 Social Physics

Prom Week allows players to solve goals flexibly, while maintaining consistent and believable characters. As introduced in chapter 4.1—and as thoroughly detailed throughout chapter 4 as a whole—CiF enables a style of gameplay coined by its creators as social physics. As previously discussed, social physics is an attempt to address many unexplored (or under-explored) spaces in video games. For example, while video games have achieved a high level of playability in physical spaces, with activities like combat, movement, and physics-based environmental manipulation all well explored, *Prom Week*'s use of social physics is an attempt to make social spaces as playable as physical spaces. The goal was not to recreate the everyday social world, but to create social dynamics specifically crafted for a targeted experience; just as platforming games do not reproduce the physics of the everyday world, but rather an enjoyable simplification tuned for gameplay, and fiction writers portray behavior and dialog in stylized fashions that differ markedly from typical conversation.

Without a system like CiF, representing social interactions between any two characters in an interactive story that take into account cultural context, personal history, and current relationships would be impractical. The space of contexts (states of the virtual world) and social interactions (player interactions) is prohibitively large and not amenable to brute-force authoring. CiF provides knowledge representation and processes that model social interactions to make this ambitious goal tractable to implement.

Prom Week's simulation of social state involves influence rules and microtheories about the following model of a social state:

- **relationships (3):** *friends*, *dating*, and *enemies*. Recall that relationships in CiF refer to binary, reciprocal and public connections between characters.
- **social networks (3):** *buddy*, *romance*, and *cool*. In CiF, social networks were scalar, non-reciprocal and private[3] feelings from one character toward another.
- **statuses (34):** *popular*, *embarrassed*, *angry at*, *pities*, *cheater*, *heartbroken*, *cheerful*, *confused*, *lonely*, *excited*, *popular*, *desperate*, *trusts*, *has a crush on*, *anxious*, and many others. Statuses refer to binary, temporary feelings that often result from multiple interactions. Some statuses, such as embarrassed, are internal private feelings. Other statuses are public and represent social standing, for example, being popular.
- **traits (44):** *competitive*, *sex magnet*, *witty*, *attention hog*, *brainy*, *deep*, *shallow*, *humble*, *arrogant*, *hothead*, *emotional*, *self destructive*, etc.; permanent attributes of a character's personality.
- **social fact database labels (13):** *cool*, *lame*, *romantic*, *failed romance*, *gross*, *funny*, *bad ass*, *mean*, *nice*, *taboo*, *rude*, *embarrassing*, and *misunderstood*. These enter the social facts database referring to the results of social exchanges, allowing

[3] Astute readers may recall that in chapter 4.4.2 that were was no theory of mind model in CiF, and that all social state was available and used by all characters when forming volitions. However, a facsimile of privacy can be produced through clever influence rule authoring. When writing influence rules, the social physics authors attempted to only take the initiator's social networks into account, but not the responder, thus "hiding" the responder's feelings from them, essentially rendering them private.

characters to recognize not only the specific social fallout of the exchange, but also possess a meta-level awareness of its nature.

- **CKB adjectives (10):** *cool*, *lame*, *romantic*, *gross*, *funny*, *bad ass*, *mean*, *nice*, *taboo*, and *rude*. These are the zeitgeist-truth values of CKB items; if an object has one of these labels, it means that it is objectively gross, funny, taboo, etc.

- **CKB connection types (4):** *likes*, *dislikes*, *wants*, and *has*. These are the personal relationships that *Prom Week* characters can have with items in the CKB. Though an item might be "objectively" lame, a particular character might still "like" it or "want" it.

For a fuller description of each of these elements of the social state please see 4.2.3.2. Given the above representation of a social state, over 5000 influence rules were created—crafted based on ethnographic analysis of pertinent media sources such as [167, 312, 20]—to represent the sociocultural considerations of *Prom Week* (though as development on the game continued, this total was pared down slightly for more pleasurable social play). The following example illustrates how this model of the social world was used to represent the target of a lighthearted high school drama.

Simon is a character with the traits "oblivious" and "witty." Naomi is a character with the trait "attractive." Simon has the status of "has a crush on" Naomi, and Naomi has the status of "popular." Naomi and Simon have the relationship "friends." Simon has a high "romance network" value toward Naomi but she has a very low "romance network" value toward him. All other network values are neutral. The CKB states that both Simon and Naomi like scientific calculators, which are lame. In the social fact database the past action Simon took toward Naomi marked with the social fact database label "embarrassing" is summarized as "Simon misunderstood Naomi asking for help on homework as a romantic advance." Because Simon has a crush on Naomi, the influence rules of the "has a crush on" microtheory will increase his desire to ask Naomi on a date. And while the microtheory for "doing embarrassing things" decreases a character's desire to ask someone out, the microtheory for his trait of "oblivious" counteracts the effect. For these reasons and others, the list of social exchanges Simon wants to engage in with Naomi begins with "ask out." When the player chooses to have Simon "ask out" Naomi, CiF determines that she will reject him. One of the reasons for this is that the microtheory for the status "popular" contains influence rules that lower a character's volition to do romantic actions with people who are not popular and especially those who have done embarrassing things recently. Because Simon and Naomi are friends, the particular instantiation chosen involves Naomi kindly letting him down.

Because *Prom Week* captures a snapshot of social norms and behaviors in a particular cultural setting, any social biases, stereotypes or other patterns of social interaction may also be encoded. The encoding is not an accident, but a deliberate authoring strategy, one aimed at producing a consideration of human values through gameplay [74]. In particular, *Prom Week* preserves certain biases from high school media for two purposes. First, to bootstrap player understanding of the social world. Second, as the consequences of these biases play out in the game, to prompt new kinds of reflections (in combination with incommensurable character goals and goal-specific endings, which make it clear that game direction and strategy are not preordained, but products of player choice). At the same time, other biases from media were deliberately omitted or inverted, such as many gender and heteronormative biases. These serve complementary functions: producing challenge and surprise as players come to recognize their absence, and reflection on what may previously have been taken for granted.

5.3 Prom Week Evaluation

While there are potentially many ways to evaluate a system powered by CiF, let us begin by presenting a qualitative look at its reception through awards and reviews. Next, we'll present a quantitative analysis of user-generated gameplay traces. After analyzing *Prom Week*, in these ways, we'll move on to discussing it through the specific lens of shared authorship.

5.3.1 Critical Reception

Before analyzing *Prom Week* game traces to learn how much the game permits players to shape their own stories, let us take a moment to explore just how satisfying the stories players produced by *Prom Week* actually are. Story quality is difficult to ascertain by simply examining play traces alone, and indeed, chapter 6.1 proposes the technique of Story Sampling that attempts to determine story quality from an author's viewpoint. To address player perception of quality informally in a qualitative sense, I'll turn to some of the critical reception and reviews *Prom Week* has received since its release.

Several trusted sources of video game news and reviews [199, 47, 278] have spoken on both the technical and emotional achievements of *Prom Week*. Game news site Rock Paper Shotgun's reporter confessed that "After the grim social strategies I'd been considering, did I deserve to be Prom King? ... Now I feel bad and impressed, and want to play it all over again." Play This Thing called *Prom Week* "... a notable advance in the state of the art of interactive narrative design." Alastair Stephens of the site Story Wonk says that "... like all successful stories, [*Prom Week*] swiftly moves beyond the mechanical, beyond the ludic, to the personal and emotional."

Prom Week garnered recognition in competitive settings as well. It was selected as a finalist in the 2012 Independent Games Festival in the category of Technical Excellence, and was also a finalist at the 2012 IndieCade festival. It won the 2012 Intelligent Virtual Agents (IVA) Gathering of Lifelike Agents (GALA) demo and video festival. *Prom Week* was also chosen as AIGameDev's editor's choice for Best AI in an Independent Game in their 2012 Awards for Game AI competition.

It can be difficult to measure the impact a game leaves on its audience. However, early qualitative and quantitative (see below) analysis suggests *Prom Week* has successfully employed innovative technology that enables previously unexplored forms of gameplay and interactive narrative. Players have unique experiences that are driven by story and character which can produce emotional, meaningful responses.

5.3.2 Data Analysis

The evaluation of *Prom Week* was done using play traces of the game generated by users. Analyzing traces generated from real play situations enables evaluating the impact and interactivity players have in their unfolding stories. Since CiF is the core of *Prom Week*, this analysis also serves as an evaluation of the impact on the story that players are afforded by CiF. Even with the large amount of variation supported by CiF in a story world as content rich as *Prom Week*, there are reasons why players could potentially be exploring a very small space of the possible story. The cast of characters in a level could have very little desire to interact with one another. Overly restrictive story goals could be constraining player choice into narrow spaces of interaction. The balance of microtheories and applicable social exchanges could leave few social exchanges for the player to choose from. Even with involving players from *Prom Week*'s alpha to its release, only a small slice of the possible game states could be seen from user testing.

To gain a better understanding of the variation in stories that players experience in the wilds of public release, a holistic and detailed understanding of the play traces is useful.

5.3.2.1 Play Traces From *Prom Week*

As players experience *Prom Week*, the system saves their interactions as traces on an external server. These traces provide data for saving and continuing play sessions and contain the information needed to re-simulate the social state created by the player. The trace is associated with an anonymous and unique identifier that represents the

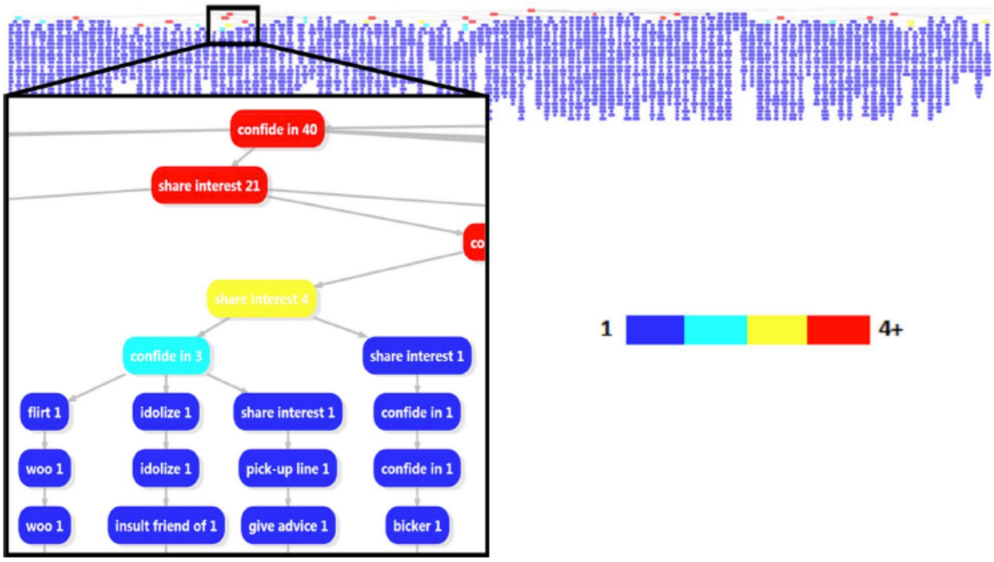

Figure 5.5: Play trace graph showing how often each distinct path through Simon's story was traversed (shown by the number associated with each node, emphasized with color). The large band of nodes seen at the top of the diagram represents approximately one third of the total size of the complete graph. The cutout shows a section of the map in detail including examples of social exchanges (like "pickup line" and "confide in") that appeared in more than one play trace. The majority of play traces are unique.

player and is used to track a player across play sessions.

Each play trace consists of the game events chosen by the player that have an effect on the social world, which are stored in the SFDB. The SFDB was designed to keep a record of CiF's activities, the social exchanges played, and enacted triggers rules. Additionally, *Prom Week* uses the SFDB to store when and how the player uses social influence points, a resource which players can use to push characters out of the comfort zone by making them behave differently than the current social state would normally dictate. When sent to the server, the SFDB is made into XML with included data about the level.

From when the game was officially released on February 14, 2012 to May 17, 2012, players have generated a total of 13,003 traces[4]. Of these traces, 7,074 took place in tutorial levels, 504 were of the goal-less freeplay mode, and the remaining 5,425 took place in *Prom Week*'s stories. Only the 5,425 story play traces generated in these first three months after the release of *Prom Week* are used in this evaluation.

The story play traces were generated each time a level successfully ended (either the level clock was clicked or the player ran out of turns) or a story ending was reached (a prom ending was seen). The release version of *Prom Week* has nine playable stories, each focusing on a different character: Chloe, Zack, Doug, Oswald, Simon, Monica, Edward, Lil, and Naomi (for a small time right after release, Kate's story was also playable). Chloe and Zack's stories are considered "tutorial" stories; they still leverage the full power of CiF, but the social goals of those levels are relatively easier to achieve.

5.3.2.2 Gameplay-Customized Story World Exploration

To get a sense of how CiF's simulation and *Prom Week*'s gameplay impact the actual choices presented to the player, level traces were analyzed and visualized using the Façade Log Analysis and Visualization Tool [245, 244], a visualization tool that aims to enhance the current toolset for studying interactive narratives. This tool helped in forming an understanding of how players were interacting with the released version of *Prom Week*. Even though the player has many options of social exchanges to choose from, it is not clear without evaluation that there are enough paths through the story space to satisfy the desires of each individual player. Furthermore, story goals, level

[4] As of the time of this writing, 67,952 traces are stored on the *Prom Week* server.

casts, and the desires of the characters themselves may restrict the options available in such a way that many players will be forced down a narrow few paths in their pursuit of story goals.

Before evaluating the variability of *Prom Week*, it is important to establish a baseline amount of variability. Some analysis of this baseline has been done on Quantic Dream's *Heavy Rain* [315], a game which places heavy emphasis on storytelling. The gameplay of *Heavy Rain* is split into small scenes, each starring one of the game's four protagonists. Though every scene offers several opportunities for the player to make decisions, with the exception of the final scenes comprising the game's climax, these choices rarely have impact on the global narrative outside the scope of the scene they were presented in. Moreover, the variability presented within a scene often is either inconsequential (there are no consequences to choices made beyond an immediate response) or boils down to one of two cases: success or failure (e.g., either the player evades the cops or gets arrested). In short, most of the variability in the story game *Heavy Rain* is not meaningful.

In contrast, there is a very large degree of variation in the way that players navigated the social space of *Prom Week*. Examining a tree map representing the social moves selected during the final level of Simon's campaign reveals that, of the 263 unique playthroughs that were analyzed, no two were exactly alike; the space was rich enough to allow for an entirely unique play trace per player. Figure 5.5 is a tree graph of the play traces analyzed for Simon's campaign. Each node represents a selected social exchange, each of which results in changes to the game state (e.g., relationships starting or ending). A path through the tree is the sequence of social exchanges a player made from the starting state in the first level (the root), to an ending (a leaf). Although there are a fixed amount of maximum turns in Simon's campaign, not all paths in the tree are the same length as players have the option of skipping remaining turns and jumping ahead to the next level. The numeric values associated with nodes comprise a heat map indicating frequency of node visitation along that specific path; some are frequently visited (i.e., several players followed that exact same route up to the point of that node), while many are visited only once (i.e., the route to that node was experienced by only a single player). For readability purposes, the nodes have been collapsed to the names of social exchanges selected, when in actuality gameplay moves are identified by the social exchange and the two characters to perform that social exchange. Including this differentiator would have further increased the branching of the tree, but I claim that it branches sufficiently to demonstrate *Prom Week*, and CiF's, ability to provide high variability.

The average indegree (times a node was encountered by a player) of a node in this graph is approximately 1.11; though as mentioned above there are a few nodes toward the beginning that are selected many times—"share interest" and "confide in" are popular starting moves, happening 91 and 40 times, respectively—the vast majority of story traces have nodes that are visited precisely once. This means the play trace is unique because no other trace is composed of the same sequence of social exchanges.

Performing n-gram analysis[5] revealed some interesting statistics on the patterns of

[5]N-gram analysis is used to find repeated patterns of varying lengths in corpora.

sequences of social moves played. Using 1-gram analysis, there are 38 unique social moves that players employed on this level, out of a total possible 39 social moves that exist in the game. Using 3-gram analysis, there are 2,521 unique patterns, of which only 80 appear more than ten times. With 6-gram analysis, there are 5,066 unique patterns of social exchanges, one of which occurred 16 times, another ten times, and all the rest less than five times. The fact that so many separate patterns exist, with so little repetition, indicates that players were able to find their own way through the story space. Moreover, the n-grams that have the most repetition are situations in which the same social exchange was played multiple times in a row. Though apparently there is a player type that relies on a strategy of brute force (for example, attempting to "woo" six times in a row), they are dwarfed by the number of other patterns exhibited.

Another interesting point was discovered by examining the tree graph of social exchanges. The sheer breadth of the tree gives a positive view of just how much variability there is in player choice; not only does the system allow for variability but also players are leveraging that variability. Additionally, though there are only 11 nodes that players chose for the first move, there are 79 different nodes selected for the second, and 143 for the third. By the fourth turn, nearly every gameplay trace is unique. Even traces with subtle differences in gameplay actions (for example, the sequence of social actions "reminisce," "confide in," "ask out" as opposed to "confide in," "reminisce," "ask out") can result in remarkably different traversals through the social state, as *Prom Week* keeps track of the specific social exchanges and instantiations the user has seen and incorporates them into future social exchange selection. Moreover, their specific ordering also impacts the formulation of which social exchanges characters want to play with each other through the use of the SFDB and time-ordered rules, thus even seemingly similar play traces can be considered unique.

The general trend of paths becoming unique can be seen across the stories and is even more prevalent in the more difficult stories of the late game. Take Oswald's story as an example, which has 390 level traces that all begin in the same starting state. Twenty five different opening moves were selected with an average indegree of 15.6. After the second move the average drops to 2.36. The average dips to 1.27 after the third turn, and hits 1.07 after the fourth. This illustrates the variability and impact that players have in their unfolding stories in *Prom Week*. The low average indegree indicates that the game is approaching a completely unique playthrough experience for each player; the large number of unique n-grams, even for small n, indicate that these unique playthroughs consist of different patterns of play; and the rapid branching factor means that the little overlap that does exist between players quickly separates into distinct traces. Given all of this, I claim that *Prom Week* was successful in providing a game space with large amounts of variability, even if, as we see below, players selected between only a handful of the total possible options on the first turn.

The relatively low variability seen during the first turn is actually positive evidence for a second goal of the system: that *Prom Week* is specifically providing large variability in the service of making stories playable. There are five characters in Simon's first level, and at the time this analysis was performed, each character wants to engage in five possible social exchanges with each other character[6] (the top five social exchanges character A wants to perform with B given the desires computed by CiF for character A). Since the player picks a unique initiator and responder, this means that there are at least 100 potential opening social exchanges (the actual number is a little higher, as players can spend social influence points to unlock additional options).

The fact that, of these hundred starting options, only 11 were ever pursued between all of the gameplay traces implies that players are not choosing moves at random, but attempting to accomplish specific story goals. The beginning of each level provides framing text which contextualizes the characters' relationships to each other with respect to campaign goals, and offers small hints about how to accomplish the goals. The hints take the form of advising the player on which characters to form relationships with, but offer no advice on which specific social exchanges to try. This means that player actions are being motivated by story goals without being dictated by them; they are playing the story, not just experiencing it.

5.3.2.3 Strategy Driven Play

To determine if *Prom Week* promotes strategic play, this section analyzes the player-driven paths through Prom Week with respect to the successful completion of story goals. To be seen as an indicator for strategic play, large portions of the story paths—variable though they may be—need to lead to successful goals. Story goals in *Prom Week* represent story states the player may make true in the story world. For exam-

[6] Changes to *Prom Week's* interface in October 2012 altered the number of social exchanges offered to players based on the volitions of the characters.

ple, in Simon's campaign, the player can choose to pursue five distinct goals, including having Simon make five friends, having Simon begin dating someone, and giving Simon an "ideal rival" by making him friends and enemies with the same person. The combination of goals accomplished determines which ending for the campaign the player receives. Though endings are mostly prewritten to leverage authorial control, there still exists template dialog within endings that allows for explicit references to specific social exchanges that were chosen by the player throughout the course of gameplay. This gives every choice the player makes—and not just goal completion—an impact on the campaign's climax.

5.3.2.4 Story Goal Completion

Figure 5.6 shows another view of the 263 traces which start at Simon's first level and progress their way through the end of his campaign. In this graph, the color of the nodes shows the impact of that social exchange on story goals. Story goal completion ranges from progress toward the goals to moving the social state away from the story goal (antiprogress). These data were generated by taking the same level traces used to generate Figure 5.5 and running them through CiF, keeping track of the goal accomplishments at each game turn.

Simon's campaign is the third nontutorial level in Prom Week and is of intermediate difficulty. Though some goals can be accomplished in just a single turn (across all 263 traces for Simon's campaign, only 13 completed a goal on the first turn, and only 17 completed a goal on the second), the rest take several turns to complete. As seen in

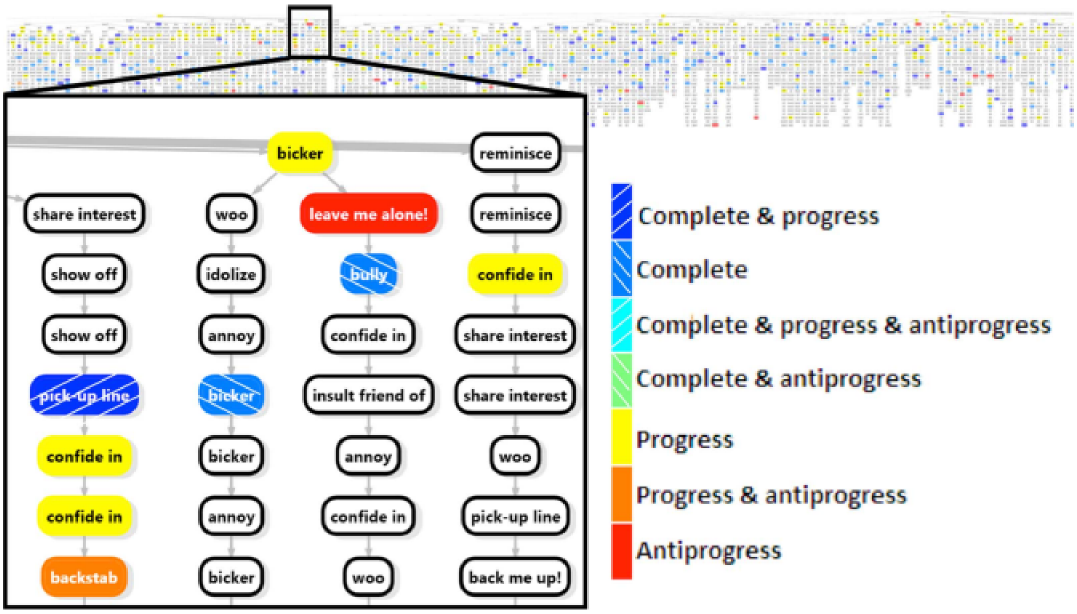

Figure 5.6: Tree displaying the amount of progress toward goals in Simon's campaign. The color and texture of the nodes represents the type of goal progress. There are three types of goal progress that can be combined in any way. Complete means a goal was completed, progress means that one aspect of a goal was made true, and antiprogress means that an aspect of a goal that used to be true was made false. White nodes mean that no progress (or antiprogress) was directly made by making that social exchange, though the social state was still changed which could lead to progress in future turns. The large band of nodes along the top still represents about one-third of the total play traces of Simon's story.

Figure 5.6, the story goals were completed by players at many points along the story paths. Of all of Simon's traces, only a single one did not contain any goal progress. All others exhibited at least some amount of effort toward achieving story goals.

Even though Simon's campaign is of intermediate difficulty, players still displayed an aptitude for achieving goals. Between all of the play traces, goal completion (on any of Simon's five goals) was reached a total of 610 times (an average of 2.32 goals per player). If every trace from every file had accomplished all five goals, the total would be 1315, which means that around 46% of all possible Simon goals were achieved. Goal progress was made a total of 837 times (an average of 3.18 times per player), and goal antiprogress—accidentally undoing previously made progress—was made a total of 44 times (an average of 0.18 times per player).

A concern when designing goals is that *Prom Week*'s gameplay—manipulating social relationships within a setting of cascading social influences in the pursuit of story goals—is fairly unique. Since *Prom Week* serves as an introduction to this genre of social puzzle game for most players, figuring out the nuances of the system to make story progress could have proven to be a challenge. And because goals are optional (and some are in direct opposition, impossible to accomplish together) we might expect few to be completed. The results are encouraging because not only were players motivated to pursue story goals, but also they were able to create a strong enough internal model of the storytelling system to be able to pursue story goals with some amount of success.

5.4 *Prom Week*, Shared Authorship, and AI-Based Game Design

I'm quite proud of *Prom Week*, and I am excited to examine it through the lens of shared authorship. Though I think this lens is a fruitful and applicable one, it would be a just-so story to claim that Prom Week was originally designed to be a piece of shared authorship. I would like to take a moment to discuss the origins of *Prom Week*, to help better contextualize my analysis of it as a piece of shared authorship.

The impetus for creating *Prom Week* was to create a compelling game experience around the social AI system CiF, and the entire game was designed with this system in mind. This methodology, called AI-based game design [64] or expressive AI [139], fundamentally changes the concerns of typical design: instead of thinking of design choices and game mechanics in terms of what existing conventional systems can do, the primary criterion for design becomes creating a game that best leverages the power of a novel system. In this case, CiF is the AI system around which the design was centered, so the changing social situations of virtual characters brought about through game play were the primary concern.

As AI-based game design is distinctly different from other game design methodologies, it has the potential to create new types of video games. The space of all possible video game designs is considerably larger than the fraction which has been explored to date. A research-centered approach has the potential to lead to unexplored design spaces. AI-based design raises the priority of technological innovation to the same level of the game design itself. In other words, with new technological abilities, new types of games can be imagined.

A benefit of AI-based game design is that the processes of designing the game, authoring content for it, and refining the AI system each inform one another, see Figure 5.7, or [270]. The act of designing game mechanics to be used in conjunction with an AI system tests the system. By exploring and determining the affordances the AI provides (or fails to provide) for gameplay, the designer exposes the weaknesses and strengths of the AI in modeling its domain, which can be used to further improve it. As the AI continues to evolve, it in turn suggests different game design possibilities. This cycle of iterative

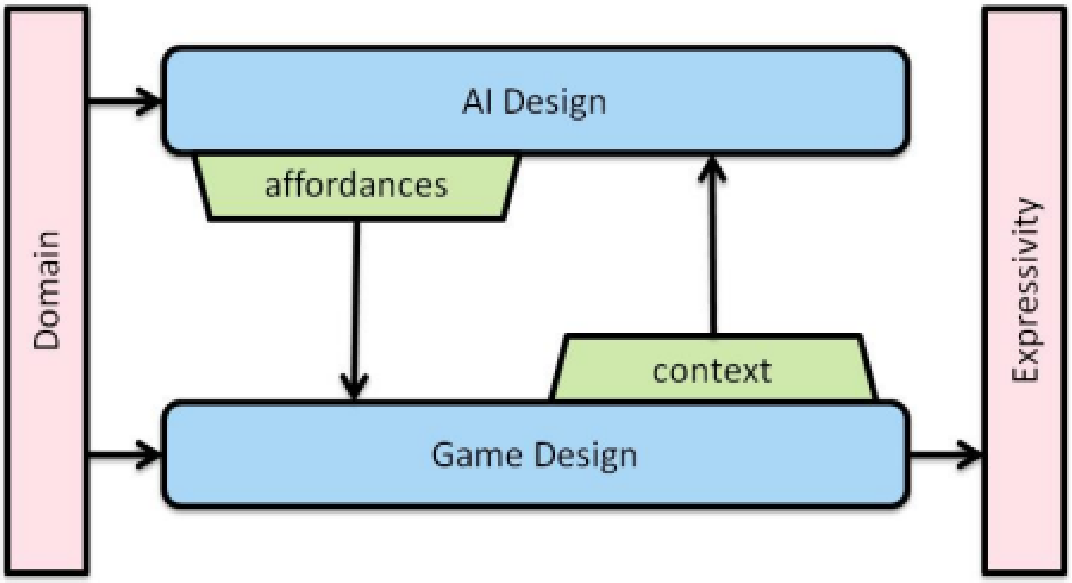

Figure 5.7: A figure representing AI based game design, courtesy of [63]. The domain (in *Prom Week*'s case, a high school styled in the likeness of popular American teen dramas and comedies), informs both the AI (CiF) and the game itself. By working on both in tandem, the growing affordances of the AI system lead to a richer game experience. As the game grows, it provides a context in which new developments to the AI system are made apparent, as well as becoming a more expressive experience for audiences.

refinement of both AI system and game improves the design and functionality of both systems: the AI becomes better at modeling its domain while the game becomes both a better gameplay experience and better at providing play in its domain. This process of creating a fully playable game based on an AI system is potentially very beneficial to developers of AI in areas such as story generation, natural language generation, and social or psychological modeling. Creating a full game with this methodology allows for many more cycles of iteration and refinement on the underlying systems, enabling a richer final product than a system developed in isolation or with only a system demo as a demonstrator.

That is to say, *Prom Week* was not specifically developed with the notion of shared authorship in mind; rather it was designed to showcase and enhance the underlying AI system powering it. However, as discussed in chapter 4, the notion of social physics was designed with some shared authorship tenets in mind; namely creating a highly dynamic procedural space that both player and system can meaningfully interact with and be capable of interpreting the effects of the interactions of the other.

5.4.1 *Prom Week*'s Strengths

Prom Week has many elements of shared authorship that, I must confess, I am quite proud of. The first, and perhaps most obvious, is the high amount of variability seen in figure 5.5, and discussed in chapter 5.3.2.2. Every single player eventually discovered a completely unique playthrough, that no other player in the history of the game had encountered. And that chart only represents about a third of actual paths that actual players encountered on a single level of a single campaign. A graph of all possible spaces—both discovered and undiscovered—across all levels of all campaigns would be astronomically larger. Now, it is important to recognize that just because the possibility space of all of these different stories exists by no means guarantees that each one of them are significantly or equally satisfying to each other. At the time of this writing, the much anticipated *No Man's Sky* [79] was recently released to mixed reviews. It's enormous procedurally generated universe was, like *Prom Week*, astronomical, but many players were disappointed by how so many of the planets—though technically unique—blended with one another, leading one reviewer to describe its eighteen quintillion planets as just as many bowls of oatmeal [135]. The ability to create a vast possibility space is an important step for shared authorship, but if the paths do not feel meaningfully distinct to players, then it is unlikely they will develop the sensation of crafting a narrative they take pride in or that has their personality embedded within it. That said, creating the possibility space itself is, at the time of this writing, still a rare enough occurrence in narrative-driven interactive media that the fact that *Prom Week* was able to achieve it is still a notable badge of honor; I look forward to the day when this becomes so commonplace that it is no longer note worthy.

Moreover, as I discussed in 5.3.1, there is evidence implying that *Prom Week* players are indeed crafting narratives they feel ownership over. Let us consider this from another direction, by first taking a step back. In many forms of play, as players understand their situation (consciously or not), they take actions that they feel are their own, rather than fully dictated by the game's designers. This could be executing a long, deep *Go* strategy or lunging for the ball in *Tennis*. Naturally, players of *Prom Week* feel that the choices they make about how characters will interact are similarly their own. But in *Prom Week* this can combine with experiences that are more common with traditional fiction. In such pieces commonly found in plays, novels, and films, an audience member may feel empathy with a character's situation or speculate about how one character might react if a second character takes some action with a third character, exercising her own theory of mind abilities in the fictional context. *Prom Week*'s underlying social situation enables the creation of a fiction, based on the audience member's actions, that reflects insights gained through these kinds of engagements with the fictional world.

As a result, *Prom Week* players have reported a new kind of fictional experience: a feeling of responsibility. I'd like to take a moment to revisit and expand upon quotes first presented in 5.3.1 that help illustrate this. For example, as Craig Pearson wrote on the games website Rock, Paper, Shotgun:

> I presumed I'd need to be nasty, but that route got me nowhere. Not that it wouldn't have worked, and horribly it makes me want to see if I could destroy Buzz, but I won the game by accidentally being nice and friendly.
>
> So now I feel bad and impressed, and want to play it all over again ... Next time I'll be looking at more upbeat solutions, because the alternative, frankly, is hating myself. [199]

And similarly, as Alastair Stephens, co-host of the Storywonk podcast, wrote:

> The complexity of these relationships is absolutely, intricately mechanical-but like all successful stories, it swiftly moves beyond the mechanical, beyond the ludic, to the personal and emotional. The temptation to manipulate these characters is enormous, but crossing that line feels... wrong. In the end, I stopped playing *Prom Week* because I didn't like the person I felt like when I played it, and I can think of no greater compliment than that.
>
> But I'll be back tomorrow, Simon. You and me, buddy. You and me. [278]

It might seem odd to quote two people saying they felt bad about themselves after experiencing *Prom Week* in a section advertised as detailing the game's strengths, but it points to something important about the playful projection of possible worlds—of vast narrative possibility spaces—as an experience of fiction. We might feel bad after watching *The Bicycle Thief* [261] or *The Wire* [263] because of the interconnected empathy we have with the characters and understanding we develop of a social system.

But we don't feel a sense of personal responsibility for how we decided to engage with that system and shape the lives of those characters.

Audiences do feel those things with *Prom Week*. Perhaps this is most obvious when they feel bad about their choices. But it also operates when they feel joy, as one player reported when he successfully inverted the high school's popularity structure and saw the results of his inventive strategy in characters' lives. If it turns out that *Prom Week* is the first example of an experience of fiction that will grow and diversify with time, the potential for a feeling of responsibility may be a key reason. And this selfsame sensation of responsibility is key to the notion of shared authorship; that the player is creating something that they feel personal ownership over and investment within. The fact that players have reported those feelings with *Prom Week* is a great sign that it avoids the trap of providing limitless, yet bland, experiences.

There is also something to be said about *Prom Week*'s basic gameplay loop, and how it adheres to the notion of shard authorship. As discussed thoroughly in chapter 1.1.1, any interaction can be thought of through the metaphor of a conversation, which is an inherently collaborative act (the two interlocutors are collaborating on creating a conversation). However, in most narrative games, the system does not "think" deeply about the actions of the player; it might still take in the player's input and then present the player with new circumstances, but they are circumstances that the system was anticipating and had an answer to at the ready (e.g., "ah, you used the rubber-chicken-with-a-pulley in the middle? Well, now you are on the other side of the island! What do you do now?"). In *Prom Week*, the system regularly (in fact, every time someone plays, as evidenced by figure 5.5) finds itself in states it has never been in before. Instead of anticipating the results, it in essence discovers them right alongside the player as it presents them. This is closer to the back-and-forth discovery, creation, and elaboration found in many non-digital works of shared authorship, such as improvisational theatre. *Prom Week* is a turn-based game with discrete moments of "player move" vs. "system thinking" which is a clear abstraction from reality, in which all parties' brains are (potentially) constantly and furiously churning. But even if the real world exists in a continuous space, it too is frequently broken down into the abstraction of turn-taking, and indeed, in many contexts people are trained to do just that (e.g., waiting one's turn to interject in a conversation instead of interrupting). Having a similar back-and-forth in a real-time environment might have more fidelity with real life, but brings with it a host of additional challenges (some of which were tackled in the IMMERSE project, discussed in 3.1 and in more depth in [257]). Though real-time continuous interaction is an obvious area for future work, I believe there is still plenty of exciting shared-authorship design space remaining to be explored—and challenges to be overcome—with turn-based experiences.

For example, one significant challenge was ensuring that the social reasoning of the characters in *Prom Week* was readable, as players were often confused by the outcomes of social exchanges played in prototype and beta incarnations of the game. They asked questions like "why did that happen?", "why did the initiator want to do that to that character?", or "why did the responder act that way?" All of this points to fears addressed in 4.4.2, namely that the system was so complex that players were not able to

Figure 5.8: A screenshot of a beta version of the game. Note how much state information was present for players at all times. The risk of overwhelming players was taken to reveal the system's depth.

interpret or predict CiF's reasoning; this was damaging to the game experience (players perceiving the character's social intelligence as random is a prime example of the Tale-Spin effect [309], as well as to the cause of shared authorship (it did not feel like the player was constructing a story with a partner making rational decisions based on their contributions). The solution that me and my fellow designers arrived at was to expose the reasoning done by CiF in a way that added to the game experience. We decided to present this information in an abstracted form, and erred on the side of providing too much detail, giving the player the ability to dig into the interface to learn the details of what was happening within CiF (see figure 5.8 for an image from the *Prom Week* beta with a particularly large amount of system information displayed).

As refinement and playtesting continued, another concern became evident: the game was too hard. With such a complex simulation, the results of any given social exchange, while believable, were often unpredictable. For example, while the interface might have indicated that two characters liked each other, an attempt to make them become friends with, say, the Make Plans social exchange might fail, perhaps because of the responder's trait of being shy, or a long-ago event in the social facts database where a friend of the initiator's did something mean to the responder. While these cases demonstrate exactly the sort of complex social intelligence we wanted to give to characters, they were not always apparent (or fun) for players. Because of this, we introduced a new game play mechanic called social influence points (SIP). SIP allows players to know more about and change how characters will respond to a social exchange before it is played. SIP is a limited resource that is increased when an unmodified social exchange is used, and decreased when the player reveals if a character will accept or reject a social exchange, changes a reject into an accept or vice versa, reveals all of the motives for why a character will respond, or forces an initiating character to select a social exchange that is not one of his top five priorities. With SIP, players can complete goals much more easily because they can carefully choose which social exchanges really must succeed to make progress towards a particular goal, and players can "nudge" the fictional world in directions they find more interesting without turning the characters into puppets. Making SIP a limited resource ensured that the majority of player choices were still governed primarily by CiF's simulation.

Although social influence points were ultimately a positive addition to the game, they do clash against some of the tenets of shared authorship; namely that it makes the narrative of *Prom Week* less "shared" by giving the player more direct authorial control, with the capability to override that which the system has proposed should transpire next. Although one could argue that the metaphor of it being a limited resource that regenerates through playing within the intentions of the system speaks to a back and forth collaboration between system and player, it is a step away from shared authorial control regardless. This is a major challenge with pieces such as this; giving the player the means to meaningfully interact with the system and to understand the consequences of their actions and how the system responds to them without curtailing the authorial control of the system itself.

Speaking of metaphors, one interesting insight regarding *Prom Week* was how the framing of the game's interface affected players. The final version of *Prom Week* (released just in time for IndieCade in October 2012, several months after its initial release in February 2012) had a completely redesigned interface that did a better job of fictionalizing the interface elements. Rather than presenting most social state information in menus or abstract information bars, these details were presented as if they were the thoughts of the characters. It seemed that by tapping into concepts that players are familiar with (such as media conventions and their own thinking about their social world) the game play experience feels less technical and thus easier for most to digest. That is to say, by presenting characters with thought bubbles; it helped convey to players that the characters were, in fact, thinking; their actions not random but the result of their sociocultural considerations. Future pieces of shared authorship would do well to

Figure 5.9: A screenshot from the released version of the game. Instead of displaying state, the game now focuses on displaying natural language explanations of character's volitions to convey depth of character thought, with an appropriate visual metaphor.

remember the importance of framing one's collaborators and one's characters as living, thinking entities. See figure 5.9 for an example of *Prom Week* displaying character's internal motivations for making a social exchange with an appropriate visual metaphor.

5.4.2 *Prom Week*'s Weaknesses

There are a few ways in which *Prom Week* clashes with some of the ideals of shared authorship. Some of these are simply *Prom Week*-specific design decisions made to enhance the pleasure of other aspects of the game. Others are difficulties pertaining to the medium itself, that will require more research, and more playable experiences, to find solutions for.

One example of an intentional design choice in *Prom Week* is the fact that the player and the system do not have symmetrical authorial control over the development of the story. Although the player must work within the boundaries presented by the system (modulo their use of social influence points, of course), it is the player making all decisions regarding the social exchanges carried out by players. Likewise, it is the system responsible for determining the cascading consequences of each social exchange. In theory, the game would be a more equal partnership, and consequently a stronger example of shared authorship, if the player had some capacity for determining social consequences, and the system had mechanisms for enacting social exchanges. Again, this limitation is not one of social physics, but was an intentional design choice of *Prom Week* itself. It would be relatively straightforward to introduce hooks into CiF that allowed players to manipulate the social fall-out; a simple example is, if multiple instantiations have their preconditions hold true, instead of CiF and Prom Week determining and presenting the most salient instantiation, it could instead accumulate them in a list, and the player chooses the instantiation they would like to see the most. Similarly, a player's use of social influence points could be thought of as an engagement with the social rule system, though it is expressly subverting the system rather than playing within it; ultimately these avenues were not pursued (save for social influence points, which were added late in the process) because it felt as if it gave the player too much authorial control over the narrative, eliminating both the challenge and the delight of surprise from gameplay.

Likewise, the simulation does actually have a modicum of control over the social exchanges that get picked. If a character's volition to engage in a certain act is above a certain threshold—one high enough that it is unlikely to be crossed through typical gameplay—then the system will inform the player that in a few turns that character will engage in an "autonomous action." That is, the character is so moved to do something that they will engage in a social exchange of their own, regardless of the player's wishes. This idea was introduced to make the characters feel, as the name implies, moderately more autonomous; like they are actually living, breathing entities with their own desires in the world, instead of puppets waiting to be utilized by the player. However, this display of autonomy was chosen to be the exception, and not the rule, for the simple reason that it is often quite difficult to get characters into particular social states, and to have them unravel the player's carefully laid plans through taking actions on their own felt decidedly frustrating. Social physics can be likened to setting up an elaborate domino trail; getting the social state positioned just right so that the right social exchange serves as a catalyst to yield the perfect social fall-out. Autonomous actions run the risk of being the moral equivalent of the player's younger brother coming into the room and knocking over the domino chain prematurely.

This form of asymmetry is not in-and-of-itself a major detriment to the cause of shared authorship—in fact I think it is an interesting example of having different authors being responsible for different aspects of the narrative—but it still begs the question as to what design decisions would have to be made differently in a piece where both player and system have equal affordances over manipulating the game state.

I discussed in 5.4.1 that *Prom Week*'s capacity for generating and facilitating emergent narrative is near limitless, and its abilities for actually recognizing and making decisions based on the emergent narrative thus far is one of its greatest strengths. However, the flip-side of that strength is that the system has a very difficult time representing non-emergent narrative; if the social physics authors want to embed snippets of specific narrative into the system, it is difficult to ensure that they will ever be seen. In fact, there are really only two examples of preexisting narrative to be found in *Prom Week*. One source is in the backstory, where characters might refer to single events in dialogue, painting a picture over time that the player is coming in *medias res* to these characters who have already shared their young lives together. The other is through a creative use of social facts database labels: certain instantiations were labeled as being an "act" within a small story-arc. These instantiations would have as preconditions that players had seen all previous acts of the story-arc. Multiple instantiations could be marked as being the same "act" to provide different ways for the story-arc to play out. An example of such a story-arc would involve an intelligent character helping an attractive character on a test in exchange for a date (Act I), the two eventually breaking up once the test was over (Act II), and then the two of them learning an important lesson about exchanging love for favors (Act III). The characters involved, the exact nature of the initiation and ending of the relationship, and the lessons learned all depended on the social state, so there was still a lot of dynamism involved in these story-arcs, but they still served as a way to inject a marginal amount of structure into the often formless emergent narrative found in *Prom Week* gameplay.

However, this solution was far from perfect. These story-arcs would require an increased amount of authoring effort, to ensure narrative consistency across all acts of the story-arc regardless of which particular instantiations the player encountered in the preceding acts. Frequently players would only see the first act of such story-arcs, making them indistinguishable from regular instantiations; this is thankfully not strictly a problem from a user-experience standpoint, but is an example of an authorial goal not being met, and often wasted authorial effort. For example, one such story-arc was a riff of the classic Dickens story *A Christmas Carol* [55], in which a *Prom Week* character is visited by "ghosts" of past friendships and relationships to help them become a better person. However, the preconditions for this story-arc were so strict—necessarily so in order to ensure a coherent narrative—that not a single player experienced a complete traversal through the story-arc[7]. And depending on the nature of the story-arc, only seeing one or two acts would leave the arc half-finished in an unsatisfying way. However, the solution could not have been to simply increase the priority or ease the conditions of their appearance, because paradoxically enough they couldn't appear too frequently, as it would have led to an undesirable degree of repetition of text. Though the emergent narrative of social physics and *Prom Week* is an exciting prospect for shared authorship, the fact that it seems difficult to weave it together with more structured narrative—if that is the authorial experience the social physics authors are attempting to provide—

[7] At least as of the time of this writing, October 2016. Perhaps in the coming months a player will stumble upon it just in time for Christmas. Given that the game has been released for several years now without the story arc being discovered, this prospect sadly seems to be humbug.

Figure 5.10: A somewhat convoluted character motivation. Chloe is inclined to give Doug advice because her friends "don't generally think Doug is uncool." Though this likely speaks to Chloe not feeling embarrassed to speak with Doug as he has sufficient social standing in her friend group, it is not immediately apparent that that is the case.

remains problematic.

Similarly, the emergent nature of the narrative made it very difficult to "debug" the world of *Prom Week* (e.g., to ensure that every campaign was still solvable after changing rules). There would be certain pockets of social state that would be much easier to "get into" than others. In order to overcome this, the *Prom Week* authors had to create small sandboxes, with hand-coded starting states, in order to test that various interactions were working as intended. Some of this authoring burden will be facilitated by advancements in authoring tools, such as those described in 4.3.3, though getting full coverage of massive state spaces through simulation will always be difficult. In chapter 6 I discuss alternative ways to evaluate the possibilities enabled by the simulation. This same emergence would sometimes yield motivations that were convoluted or confusing for players, making it difficult to anticipate the responses of their "collaborator" (see figure 5.10 for an example of a somewhat convoluted character motivation).

Seeing and testing how the simulation is currently working with the mindset of "solving," "fixing," or "improving" it is potentially problematic in and of itself. Clearly the social physics authors have some amount of authorial control they are attempting to encode (for example, *Prom Week* authors were attempting to create a work that could emulate the types of fictions commonly found in high school narratives commonly depicted in American media), but at what point does the social physics authors enacting their own authorial control over the system violate an opportunity for shared authorship with the very system they are attempting to create? In [290], the thought is proposed that altering and limiting the possibility space of story generators is curtailing their creative potential. It is an interesting thought; and one that is difficult to reconcile. This dissertation is all about attempting to create technologies that can be treated as creative partners, but to do that the technologies still must be created; at what point does the creator of such a technology stop viewing the system as "buggy" or a "work in progress" and instead accept its output and processes as complete; even if they differ from what was originally envisioned? This philosophical quandary is conveniently avoided by focusing on shared authorship between player and system, though it remains an important question that will need to be pursued in future work.

What this future work looks like is an interesting conundrum. As of right now, *Prom Week* does not allow for the rules themselves to be changed at all by the player; the social knowledge encoded by the social physics authors is law. As we've discussed many times, this means that the player is sharing authorship with the system, which in turn is reacting dynamically to the player. However, the system itself is a puppet of the social physics authors. One potential solution is to allow the player to have some measure of direct control over the rules, which would increase the amount of collaboration between player and social physics authors—the player would see the initial offering of the social physics authors and be able to build off of it—but unless significant structural change were made to the nature of *Prom Week* this collaboration would merely exist in one direction (i.e., the social physics authors are not able to perceive, let alone react, to these player-made changes). Moreover, it would ultimately reduce the amount of collaboration between the player and the system, as it increases the player's level of direct authorial control. An analogy that might be useful is an improviser giving notes to a fellow improviser after an improv show. Although the culture of sharing notes shifts from troupe to troupe, in many theatrical contexts it is considered a grievous faux pas for actors to give each other notes (doing so remains fairly in the purview of the director or coach). In both of these contexts (note-giving and rule-editing), one is still collaborating with the other, only now there is "more of themselves" in their partner. In an improv context (or most contexts with humans interacting with each other), at least both humans have the means of sharing notes to each other, both of them leaving marks on the other. In a social physics system in which the player can adjust the ruleset, the system has no such luxury.

I already mentioned the ultra-reliable narrator/writing partner of *Prom Week* in my discussion of CiF and Ensemble in 4.4.2. Though, as discussed in 5.2.2, there are some clever authoring tactics employed to add layers of mystery and uncertainty to the characters (e.g., a character might still ask a character that hates them out on a date, because the social rules written basically make it so that characters do not know if other characters hate them or not unless they have made public demonstrations of their rancor), in general all characters have an accurate and immediate awareness of all elements of the social state. This limits the types of stories that can be told, and is another example of the asymmetry between the player and the system, in that the system has perfect knowledge and uses it to inform its reasoning, while the player likely does not.

It also must be acknowledged that *Prom Week* transpires in a very specific domain: that of a high school in which all of the student body is fully occupied with preparing for their senior prom. As previously described, the quantity and variability of the stories *Prom Week* is capable of producing (and enabling the player to produce) in this domain is vast. However, if players wanted to tell stories outside of a high school, or indeed, about a different component of high school—such as the student body cramming for final examinations—much of the social knowledge encoding for *Prom Week* would have to be revised and rewritten entirely. This is not a trivial task, as the creation of social exchanges, influence rules, and microtheories took the *Prom Week* team a considerable amount of time to produce and iterate upon before arriving at the final set of rules and exchanges that ultimately made their way into the released version of the game. Though proposals such as those made in chapter 4.3.4 could foster a community in which many authoring hands make for lightened authoring load, this specificity of knowledge representation seems to be inextricably connected to the metaphors of social physics, making each new domain explored a significant undertaking.

Although the goals of *Prom Week* were designed as a way to bootstrap play and facilitate engagement with the simulation, some have critiqued them for detracting from the narrative of the piece, and making the game feel more ludological in nature, such as in [168]. This is a fair critique[8], however, I am happy that this paper hinted at feeling a deeper emotional connection to *Prom Week*'s characters than were felt towards *Façade*'s Trip and Grace; a huge honor considering how inspirational *Façade* was to the design and implementation of *Prom Week*. The paper also cites *Blood and Laurels* as the favorite game amongst the four that were surveyed, as it did the best job of achieving Wardrip-Fruin's *Sim City* effect (akin to his *Tale-Spin* effect, though one in which the representation of the game gives one a deeper appreciation of the underlying simulations of systems which power it, which in turn affect how one views similar systems in one's own life). Though implemented via the Praxis [71] system instead of CiF or Ensemble, it is still spiritually similar to the notion of social physics, speaking to the affective

[8]Though interestingly *Prom Week* has also received personal feedback from Dan Benmergui, creator of *Storyteller* [13] that the instantiations, representation, and performance of the evolving social state detract from what he perceived the real pleasure of the game to be: manipulating social state change values. So, one player found the game to be too mechanical, another found it to be too narrative-focused. This, perhaps, simply means that one cannot please everybody.

power of the metaphor has a whole.

5.5 Closing Thoughts on *Prom Week*

I have now thoroughly discussed *Prom Week*, one of only a few games fully powered by social physics, and a prime example of a piece of shared authorship. Though examining *Prom Week* through this lens has revealed ample ways in which the nature of its shared authorship could be altered or improved, hopefully the reader agrees with my claim that its vast variability within its narratives, and the emotional impact they have the capacity to produce within its players, make it clear that *Prom Week* is a notable step forward in collaborative narrative authorship.

I'll end this section by revisiting our visualized shared authorship design space from chapter 3.3, and ranking Prom Week across the shared authorship design dimensions described in chapter 3.2. First, let's see how *Prom Week* scores across the dimensions.

	Human Collaborator	Performing Collaborator	Immersion	Simulation	Playtraces	Visible Collaborator	Reliable Collaborator	Game States	Space and Convergence	Visible Story Values	Cohesive Final Product
Prom Week	2	2	1	4	4	2	4	4	4	3	3

Table 5.1: Ranking *Prom Week* across the dimensions of chapter 3.2.

As we have already discussed above, we can see that *Prom Week* scores very highly

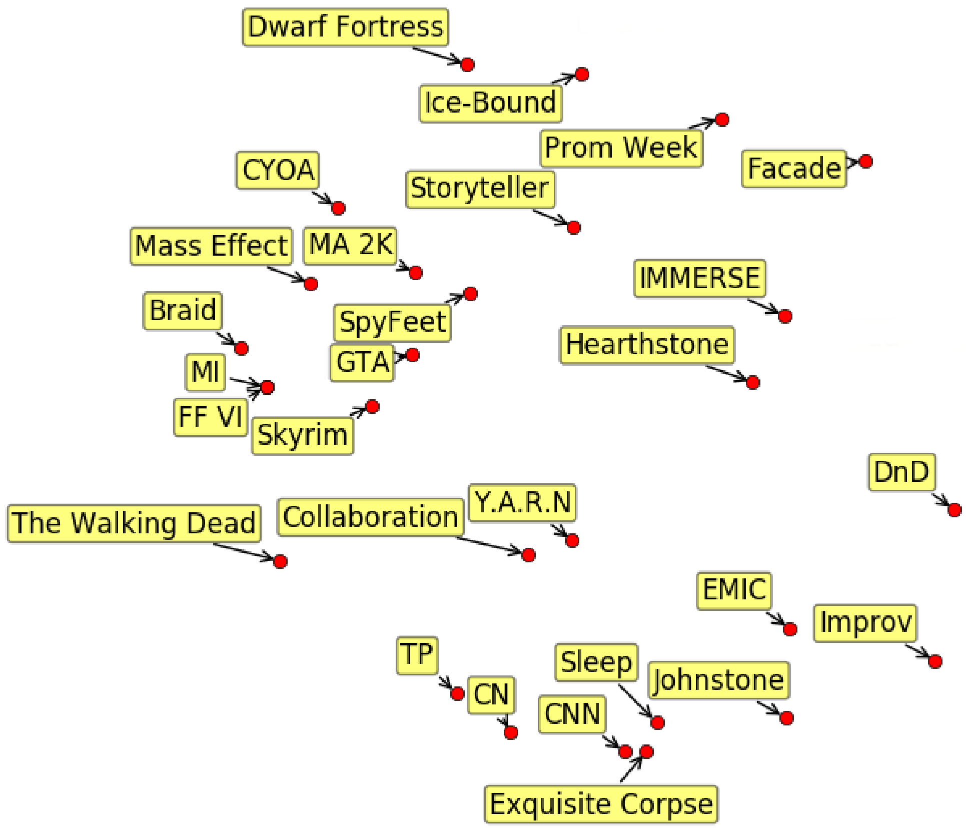

Figure 5.11: Revisiting the visualized design space of shared authorship, now with *Prom Week* included, sitting comfortably between the seminal interactive drama *Façade* and *Ice-Bound*, an impressive work of sculptural fiction.

across many of the dimensions, including the power of its simulation, the number of playtraces it is capable of producing, and the number of unique game states it is possible to wind up in. The sense that one is actively working with a collaborator though scores somewhat lower; although players are aware that there are simulation forces at play dictating character behavior, as I outlined above, sometimes those forces can be difficult for players to interpret or make sense of.

With this ranking, it is now possible to add *Prom Week* to our design space as first presented in chapter 3.3. By examining figure 5.11, we can see that *Prom Week* is situated comfortably between *Façade* and *Ice-Bound* in the upper right quadrant of the space. This is heartening, not only because those two games are lauded as seminal pieces of interactive narrative, but it further reinforces the upper-right quadrant of the space as a desirable space to aim for. The pieces here make use of ample simulation, and give the player substantial ways to adjust the narrative. They also all feature virtual agents (*Prom Week*'s cast of characters, *Ice-Bound*'s KRIS, and *Façade*'s Grace and Trip) with their own histories and desires, that the player must work together with to shape the unfolding the story. As I continue to discuss more of the pieces I've made, I will return to this diagram again to confirm that the pieces continue to explore this design space. Before moving on to my next game, though, there is a little bit more that I would like to share about *Prom week*.

In my discussion of *Prom Week*'s strengths and weaknesses, I mentioned the difficulty of being able to evaluate the nature of the stories the system is producing, and how that aligns with the social physics authors' authorial intent for the system. In the following chapter, I will begin a discussion of a few technologies and evaluation methodologies that have been applied towards this very cause.

Chapter 6

Story Sampling, Gamalyzer, and Playspecs

Much of the dissertation up to this point has been focused on creating technologies and playable experiences that enable shared authorship. I have thus primarily been examining these existing pieces with an eye for the player's experience, since the default is for the game designers to produce a story that the player consumes and experiences. All the same, it is important to recognize that the game designers likely have an authorial voice or message that they are hoping to convey through the creation of their playable experience. Verifying that authorial goals are being reached in systems where the players themselves have some level of authorial control is a challenge. This chapter will introduce a few tools and methodologies—namely Story Sampling, Gamalyzer, and Playspecs—that one might employ to ensure that the stories that interactive narrative systems—and their users—are producing are in line with the authorial goals of the system designers[1].

These techniques are broader than shared authorship, and can be used to reveal insights into most pieces of interactive narrative with emergent properties, answering questions for system designers that might be difficult to otherwise discover, such as confirming the existence of potentially undesirable properties in generated artifacts, such as the repetition of dialogue, the existence of subversive play from players, or the discovery of unwinnable game states as described in chapter 2.1.1. Though any of the above would be relatively straightforward to discover in a narrative with ample hand-written, hand-sequenced text, any piece which permits players to shape their own narrative runs the risk of producing undesirable—or worse, unintelligible—stories. In *Expressive Processing* [309], Wardrip-Fruin notes how in the game Knights of the Old Republic [16] how, even with relatively few branching paths, it was still relatively easy to—unintentionally—work the game into a state in which characters were behaving as if they were at a different point along the quest-line than the player was, resulting in bewildering, seemingly uncharacteristic dialogue. If such issues can occur with with the relatively static operational logics of quest flags and dialogue trees, it stands to reason that the risk of similar befuddling moments is greater in highly dynamic systems, such as the social physics engines of CiF and Ensemble.

As I have made the claim that dynamic systems such as these are vital to pieces of shared authorship, mechanisms intended to analyze the artifacts produced by such systems are valuable. As this chapter unfolds I move from the most to least concrete

[1]To be fair, these tools were first introduced in prior publications, from which this chapter draws heavily from, namely [247, 195, 192].

in terms of these tools and their current applicability to shared authorship. I begin by discussing Story Sampling; the technique that has already yielded the most direct insight into *Prom Week* as a piece of shared authorship. I then move on to Gamalyzer, which has revealed an interesting potential disconnect between a designer's perception of *Prom Week* and reality. Finally, I discuss Playspecs as a potential tool for both analyzing—and creating—pieces of shared authorship; though Playspecs has yet to be used in an evaluation capacity, chapter 8 introduces a shard authorship prototype which plans to leverage Playspecs.

6.1 Story Sampling

Interactive narratives are complex systems, and it can be very difficult for creators of these experiences to anticipate how users will ultimately interact with them. Although the nature of the interaction changes from game to game, player interaction in interactive narratives leads to branching, non-linear, or otherwise dynamic ordering of narrative content. Content creators authoring for these types of experiences likely have narrative goals they are trying to achieve, but the dynamism of the content makes authoring for these goals a challenge. Without the privilege of seeing the story ground out on the narrative level for each player, it is difficult to ascertain the shape of the narrative experience being created. Data mining and visualization techniques are commonly used in games to understand how players are interacting with a system, and many valuable insights can be gleaned from their use. However, these techniques only go so far in addressing the above issues in the domain of interactive narrative because they lack narrative specificity: they don't provide a feel for what is going on in the story.

This chapter begins by presenting the technique of story sampling[2] for assisting in the authoring and evaluating of interactive narratives. Story sampling, when used in conjunction with traditional data mining and visualization techniques, can help provide some of that missing narrative specificity. The technique can be broken down into four steps.

- **Step One:** Generate play traces. These might be created by testers during a game's beta period, or be logged by players post release. Regardless of where they come from, it is important that they provide enough details to reconstruct the player experience of the narrative, either directly or through post-processing.

- **Step Two:** Filter the play traces from step one, identifying traces that represent (potentially) interesting or problematic patterns of player experience. For example, if concerned about the amount of repetition of dialog in a system, find traces that contain repetition in dialog. There are myriad proven data mining and machine learning techniques for filtering data, such as clustering algorithms, which though undoubtedly fascinating, do not require an in-depth understanding to appreciate their application to filtering, and therefore will not be discussed in detail.

- **Step Three:** Take the play traces from step two and organize them into story

[2]The notion of story sampling was conceived by myself, Josh McCoy, Mike Treanor, Aaron Reed, Michael Mateas, and Noah Wardrip-Fruin.

beats. By story beat, I refer to "the smallest unit of character performance that changes the story" [163]. Whereas the play traces from step one are likely machine readable, it is important that these story beats, be they lines of character dialogue, narration, animations, short videos, or otherwise, are human readable. This likely involves the construction of an additional system to automate the beat identification process. Doing this extra work to represent traces as sequences of human readable story beats is vital for allowing authors to make value judgments about the quality of story sequences.

- **Step Four:** Have humans (e.g., authors, game designers, players) look at the story beats generated from step three and make judgments about the quality of the system as a whole. Use those judgments to inform future authoring and system design.

I have found, along with my *Prom Week* colleagues, that story sampling can be a very useful approach for identifying and fixing issues with an interactive narrative system, as it helps to identify the causes of a system's problems, not just their existence. Moreover, story sampling can reveal "false positives" as well, such as situations that might appear undesirable after running through the filtering of step two, but in actuality are fine, or even desirable, when presented as story beats.

Now that we have the basic premise under our collective belt, let us discuss an example of how story sampling might be used to evaluate an interactive narrative. And what better interactive narrative to use than the one we have been so focused up to this point and that we have ample data for with which to perform an evaluation: *Prom Week*. Thorough descriptions of *Prom Week* and CiF (the AI system that drives the game) can be found in chapter 5 and chapter 4.2 respectively as well as in various publications [155, 153, 160]. Even so, it is worthwhile to briefly describe the authoring process for *Prom Week*, which implements a novel approach for interactive story generation and lends itself well to story sampling.

As discussed in chapter 4.2.3.3, authoring done in *Prom Week* is retargetable; dialogue is not written with specific characters in mind, but rather for specific social states. Any pair of characters can theoretically engage in any authored conversation, as long as the social circumstances that are the preconditions for that conversation hold true for those characters. These conversations, called instantiations since they can be instantiated in a wide array of contexts, are *Prom Week*'s story beats. This approach helped address the authorial burden commonly present in interactive narrative experiences, but made it difficult to evaluate stories generated during player interaction. Although traditional data mining provided some good insights, the *Prom Week* team found it didn't fully support us in understanding the space of dynamic stories generated through player interaction. Story sampling enabled us to get a better view on actual player experience, and consequently, better identify strengths and weaknesses of the system.

6.1.1 Work Related to Story Sampling

Data mining and visualization have been used in a variety of game design contexts. Heat maps of the first-person shooter *Halo 2* were generated via user tests while the game was under development [115, 296] and identified the primary areas where players were dying, leading to discoveries of unintentional difficulty spikes. This is similar to story sampling in that data mining led to the discovery of problem areas. However, where a heatmap was a very effective visualization tool for a game that heavily relies on spatial navigation, it is less applicable to the domain of interactive narrative, where physical movement tends to be less important than the story choices that were made.

Visualizations of the paths through specific branching narratives exist as well [117]. In some narrative authoring environments, the visualization is heavily integrated into the authoring process [14, 15]. Though these techniques can answer questions regarding how many paths a player can take in an interactive narrative—and indeed, as discussed in chapter 5.3.2, such techniques revealed a striking amount of variability in paths taken by *Prom Week* players, they still do not address questions pertaining to the narrative quality of any individual branch.

Large amounts of high-dimensional data is generated by players playing video games. To learn something meaningful or to predict based on this data, many research projects use machine learning and datamining techniques [90, 164, 174, 314]. Algorithms that reduce the dimensionality of player-derived data have been used to find play patterns in *Tera*, *Battlefield 2* and *Tomb Raider* [58, 262]; and determine types of players in serious games [124]. In this work, the weaknesses of these purely computational approaches are buttressed by strategically integrating human authors via story sampling.

6.1.2 Story Sampling Example: Repetition of Dialogue

Repetition of text is often considered undesirable in games, particularly when the repetition comes in the form of character dialogue. Human players are very good at identifying when text has been repeated, more so than recognizing repetition in animation; this is one reason why games often re-use the same animations throughout, but will leverage herculean authoring efforts to try to produce novel dialogue content. In the domain of animation, the technique of retargeting gets more use out of any single animation by having the same animation be usable by multiple models [292]. Although there are perhaps as many ways to gracefully handle repetition of dialogue as there are interactive narrative systems, it is common across many systems for authors and game-designers to be unsure of the narrative effects dialogue repetition is having on their game. Story sampling is a tool that can provide a view into this often opaque quality.

As detailed above, *Prom Week*'s dialogue system is philosophically very similar to this notion of retargeting. For example, an instantiation in which two characters break up with each other could be retargeted to be played out with any two characters that are currently dating (and, as discussed in chapter 4.2.3.7, the scene would have character specific locutions and references to their particular social context). This technique of retargeting dialogue reduces authorial overhead by quite a bit; authors need only write a single instantiation instead of writing a different break up scene for every possible combination of characters. To illustrate the magnitude of this for *Prom Week*: its eighteen characters would necessitate three hundred and six different variations of just this single scene. The tradeoff is that even with the natural language generation techniques that *Prom Week* employs, reusing the same instantiation opens the potential for large amounts of dialogue repetition.

Astute readers may recall that *Prom Week* attempted to mitigate the problems of repetition by making the dialogue templated. Some elements or "locutions" of these templates are purely pragmatic, such as having characters refer to each other by their correct names and gender pronouns. Some were meant to introduce some variation in the scene, such as the "random" locution in which authors specify a variety of text snippets of which one is chosen at random. Others allow for the personalities of the characters involved to shine, such as character-specific locutions (every character has unique greetings, affirmations, and insults, for example). In *Prom Week*, every instantiation, and the effects it has on the social state (e.g., after a break up scene the two characters involved are no longer dating) is placed into CiF's Social Facts Database (SFDB). Characters can reference the events in the database in later exchanges; for example, two characters can reminisce about a positive interaction they shared earlier in the game. Since both the identity of the characters speaking this dialogue and the contents of the SFDB are dynamically determined through gameplay, and thus unknown at authoring time, it is difficult to know if the actual stories generated by play are in line with the authorial intent behind the instantiation's creation.

Even with measures such as the above taken, it would be naive (or, perhaps, speak to a very limited player base) to not expect there to be some dialogue repetition present in *Prom Week*. The hope was that the use of multiple characters and templates would make any given instantiation vary significantly, reducing negative impact even if it was seen by the same player multiple times. Though the game had many means of varying the content of the dialogue, there were questions surrounding how best to make use of them. How effectively did use of the random template make an otherwise static line of dialogue feel dynamic? Were the simplistic character-specific locutions actually making a discernible difference when two different sets of characters engaged in the same instantiation? Intuitively, making frequent use of the SFDB seemed like a powerful use of the system, but were there certain situations where referencing character history was more powerful than others? Having the answers to these questions would have helped focus the *Prom Week* authoring effort substantially, giving the game's authors the knowledge needed to better write for this new domain of retargetable social exchanges.

To find answers to these questions, data mining was used to identify the types of instantiations that were being repeated during single runs through the game, and the frequency across these runs with which they were seen. These instantiations were identified by searching the 109,984 playtrace files generated by players between the initial release of Prom Week to November 22nd, 2013. *Prom Week* is split into several campaigns, which in turn are made up of a number of levels. A new playtrace is generated at the completion of every level, and contains all of the player actions taken in that level and all prior levels in that campaign. Due to this cumulative nature of the playtrace files, only files that marked the end of a campaign were considered, or 15,967 unique playtraces. Each playtrace is an xml file that catalogues all user moves, and contains all requisite information to be able to recreate the social state the player would have experienced. For every instantiation that was written in the game, it was checked to see how many traces contained the instantiation multiple times. Although the results were interesting—some instantiations were never seen more than once in a single playthrough while others were frequently seen multiple times—it largely just confirmed the initial suspicious that the technique of retargeting can and does lead to repetition. The questions that actually needed answering—questions pertaining to the effect this repetition had on the narrative—involved discovering the narrative quality of the stories that contained repetition, and data mining alone was insufficient to help us see the answers.

The technique of story sampling was developed in part to achieve this very goal. Six instantiations that appeared multiple times within a single playtrace were selected for analysis. These six instantiations possessed a range of the types of locutions used; half of them used the SFDB, which were hypothesized would make instantiation repetition feel the least egregious. Of the remaining three, two made heavy use of the random locution, and the last only made use of the pragmatic templates and character specific locutions, which it was predicted would have the worst results. For each of the six selected instantiations, three play trace files were found in which the instantiation appeared two or more times. These playtrace files were then run through a custom-built transcript generator, which generated the dialogue that the user playing the game would have actually seen. The transcripts were then passed off to the lead author of the game and another game author along with a rubric; using the rubric, the two authors were asked to read the eighteen transcripts and give each a rating from zero to three. A rating of three indicated that the repetition was either completely unnoticeable, or it was noticeable but it actually enhanced the quality of the transcript. A rating of two meant that the repetition, though noticeable, felt different enough during each occurrence (either due to variations in the dialogue or to the differing social contexts in which the two instantiations occurred) that it didn't feel completely out of place. A rating of one meant that the repetition was highly noticeable, in spite of text or contextual variations, and a rating of zero meant that the repetition was simply unacceptable and detracted from the quality of the story. The authors did this rating independently of each other, and then reconvened when finished to discuss their results.

The raters agreed precisely on twelve of the eighteen transcripts, and were always within a difference of one for the other six. The twelve with highest correlation of agreement contained a sampling of all four rankings; three transcripts were rated with 0s, five with 1s, three with 2s, and one with a 3. Although the raters nearly agreed with each other on every transcript, looking at the transcripts with perfect agreement is important because they epitomize characteristics that the authors identify as desirable and undesirable for the stories the system creates. Some of the findings were to be expected; zeros often came from playtraces in which it appeared the player was 'grinding' a particular action, repeating it again and again with the same group of characters, and thus not providing the game with material to create new interesting contextual cornerstones. However, other discoveries provided new views into what makes repetition more or less acceptable in *Prom Week*. One of the greatest determining factors was simply time elapsed between the two occurrences of the same instantiation. Even in situations where the exact same text was produced, if enough other dialogue had transpired between the two instances, the authors were inclined to give the transcript a rating of a 1 or 2. Several other insights were gained with regards to use of references to the SFDB. Although, as hypothesized, several of the highest rated transcripts made use of the SFDB, I was surprised to discover that some of the lowest rated ones did as well; contrary to our initial authoring beliefs, the SFDB was not a cureall. This enabled the discovery of common patterns of successful, and less successful, SFDB use.

The best uses were when characters specifically referenced an event during the second instantiation that had happened after the first; this felt good because it showcased how the characters, and consequently the system, are reacting to new story beats that had been introduced to the world, even if they were reacting to them with largely recycled text. Surprisingly, the repetition of this recycled text was identified by the authors to be pleasurably comical, though admittedly when seen too frequently began to feel artificial. There were transcripts where the exact same SFDB reference was pulled in both of the instantiations, though even these were discovered to not be ubiquitously problematic; the SFDB stores two types of references: actions done by the player during gameplay as previously described, and 'backstory' references, events written during the authoring process which prepopulate the SFDB when the game begins. Repetition of backstory references was generally much more jarring than repetition of a reference to something the player actively made happen. The latter felt like the entire student body was abuzz with the characters', and consequently the player's, latest exploits; the former felt like they were at a loss of things to say and were dredging up irrelevant facts from the past.

In addition to enabling the authors to recognize differences between acceptable and less desirable instances of repetition, story sampling led to design insights that could be used to minimize the latter. Random locutions, in their current implementation, can only change a single line of text; this makes it impossible for future lines of text in the same instantiation to reference the text snippet the random locution selected. However, this look into transcripts showed that the random locution went a long way towards reducing the disruption of repeated text. If randomness could encompass changing multiple lines, it would become an even more effective tool for variation. The system also does not keep track of how many times a specific option in a random locution is used; prioritizing random options (or applicable SFDB references) that have not yet been seen would enhance their effectiveness. Moreover, frequently some of the random options are sillier than others; this could be a useful moment to let characters' personalities shine by having goofier characters be naturally more inclined to use the weirder random options, while more conservative characters would tend to stick to normal utterances (an effect which could be proceduralized by ordering the random texts from least to most unexpected). The team also discovered that character-specific mix-ins were very useful in lessening repetition as well; they take linear authoring effort, but deeply enhance characters' expressivity. Adding more types of character specific locutions, and more options for each locution, seems like an easy win.

Another design insight is to author instantiations in which characters acknowledge the repetition. If characters continue to refer to the same SFDB event, it could trigger a new class of instantiation in which characters react to the fact that the same situation keeps appearing, which could help retain the inherent humor in repeated references to the SFDB. A similar technique could be employed when players continue to grind the exact same social exchange between characters: instead of playing the same social exchange for the nth time, the system could redirect to a "persistent" social exchange, where the character is called out on their repetitious behavior (for example, shouting out "stop flirting with me!").

Though these results were generated with the benefit of thousands of playtraces, the fact that ultimately only eighteen playtraces were analyzed in depth implies that a similar story sampling process could be carried out with a smaller pool of logs as well, perhaps using playtraces generated during a game's beta period. This would allow the insights from story sampling to inform the game design and authoring process before release.

6.1.3 Story Sampling Example: Multiple Interpretations

Another consideration of *Prom Week* and its retargetable social exchanges, besides a general fear of repetition of dialogue, was to verify that the instantiations being written felt appropriate given the wide diversity of social contexts they could be found in. Ideally, not only would the instantiation not violate any of the current narrative or social context, but could be in fact be read through the lens of of those contexts to take on additional meaning. Here, I describe a similar story sampling approach in which a single instantiation is interpreted in different ways across multiple contexts. While it cannot be said for certain that the player that generated the gameplay interpreted the sequence of social exchanges in the ways described, the provided interpretations are indicative of the dramatic social drama *Prom Week* is able to create because story content is directly linked to the social state managed by CiF.

The example is a possible outcome of the social exchange Ask Out, in which the responder tragically refuses to cheat on the person he or she is already dating, despite sharing feelings for the initiator of the social exchange. This scene of dialogue will be referred to below as the "tragic rejection." The uninstantiated dialogue for the tragic rejection is:

INITIATOR: RESPONDER, I have a proposition for you. Hear me out. I know you're dating DATING_RESPONDER, but you need someone who really understands you and cares about you, too. Someone... like me.

RESPONDER: Oh, INITIATOR. I would be lying if I said I didn't sometimes wonder whether we could be together. But I just can't right now. I'm with DATING_RESPONDER, and I couldn't cheat on PRONOUN_OF_DATING_RESPONDER. It just wouldn't be right.

INITIATOR: But, we're so right for each other! Can't you see we were meant to be together?

RESPONDER: Stop it. Just stop. We can't. We just can't, okay? You should go.

INITIATOR: I'll always be here if... if you change your mind.

When put into the context of particular characters and varying social history, this scene of dialogue takes on a variety of narrative roles and meanings.

One interpreted story from a play trace involves the characters Monica and Nicholas (who are dating) and Cassandra. The story begins with Nicholas trying to break up with Monica and Monica talking him out of it. Next, Monica, feeling rejected, makes several romantic moves toward Cassandra, to which Cassandra reacts poorly. Nicholas, feeling jealous and irritated at Monica, chews her out for flirting with Cassandra. Now, the tragic rejection: Cassandra, given some time to think about Monica's advances (which were confusing to her at first), asks Monica out. Monica, feeling bad for making Nicholas angry, has decided she doesn't want to be a cheater, and refuses.

In this story, the tragic rejection has taken on narrative meaning that neither the system nor the authors anticipated, though is consistent with the characters and the choices the player has made. In the context of the story, Monica's torn refusal to date Cassandra implies that Monica felt remorse for her previous flirtatious behavior. It also paints her earlier actions with Cassandra as baiting Nicholas into caring about her. Once Nicholas showed her he cared, by getting angry with her, her desire to get together with Cassandra was lessened. This interpretation of the tragic rejection reveals Monica to be manipulative and gives us reason to pity Cassandra.

Another play trace involves the characters Doug and Jordan (who are dating) and Chloe (who is friends with Jordan). It begins with Doug and Jordan having a tender moment where Jordan reveals something embarrassing about herself, and they talk about how they need to trust one another. Next, Chloe flirts with Doug, and he responds politely. Next, Jordan goes to confront Chloe about this, and she can't bring herself to be mad at her friend. Then, right after Jordan compliments Doug, Chloe tries to date

Doug, and the tragic rejection plays out (where he admits to having feelings toward her but ultimately rejects her). In this case, the tragic rejection can be interpreted as revealing both Doug's weakness for romantic attention and his loyalty to his present romantic partner.

Another play trace involves Kate and Nicholas (who are dating) and Oswald. Oswald tries to steal Kate away from Nicholas and she refuses flirtatiously. She then ups the ante and invites him to hang out outside of school. Oswald then opens up about his deep feelings and Kate rejects him because she doesn't want to cheat on Nicholas (the tragic rejection). Nicholas then dumps Kate and with that Oswald and Kate get together. In this story, the tragic rejection was just part of a story about Kate and Oswald wanting to be together, but being held apart by circumstance. It also suggests that Kate, while demonstrating loyalty, might also have the inclination to be a cheater.

The space of possible worlds in most single-player video games is highly limited by the amount of pre-authored narrative content. As discussed above, CiF enables a very wide degree of narrative responsiveness during play. Play trace data collected from *Prom Week* suggests that these possible worlds not only exist, but they are also being explored. While an individual stage might present only a few initial options, the possibilities branch out extremely quickly. After just a few moves, players are almost all in their own unique world. Given the narrative significance of these differing worlds, CiF enables numerous playable stories.

6.1.4 Closing Thoughts on Story Sampling

This concludes my introduction of the technique of story sampling, in which realized story beats generated by players of an interactive story are analyzed to provide views into the shape of the narrative experience that data mining alone does not provide. The example use cases above provided an understanding of the types of experiences the game created that are difficult to ascertain at the time of writing, since their realization is heavily dependent on the context of the player's particular playthrough. This naturally led to ideas for improved game design and authoring efforts to ensure that the dynamic narrative content generated by game and player is in line with authorial goals.

Story sampling proved effective for understanding the shape of narrative experiences generated by *Prom Week*, but there remain many promising directions for future work. Implementing the new features of CiF and *Prom Week* inspired by this evaluation, and then employing further story sampling on the revised systems, would further verify the efficacy of story sampling. Though *Prom Week*'s story beats took the form of character dialogue in instantiations, it would be illuminating to see if story sampling is as effective in domains where story beats took different forms, such as narration or animation. *Prom Week* was also a finished product; applying story sampling in an environment in which the interactive narrative is still being developed, such as a beta, could reveal how useful story sampling is in shaping authorial direction when integrated into the active game design process. And finally, the four step process of story sampling is potentially generalizable to domains other than interactive stories. For example, it would be interesting to see the story beat equivalent of the play traces used to generate the *Halo* heatmaps (perhaps a short video from the player's perspective leading to the moment of death). The heatmap showed that players were dying; story sampling in this case might better illuminate why they were dying.

I also believe that story sampling helps demonstrate that *Prom Week* is succeeding as a piece of shared authorship, at least in certain regards. Namely, it shows that the artifacts (i.e., the stories) produced by players are satisfying the creators of the system, at least in the few ways analyzed above. Though throughout this dissertation shared authorship has largely been viewed through the frame of a player collaborating with a system, since these systems (or, at the very least, *Prom Week* and CiF) have encoded models and structures determined by their creators, engaging with these systems is in part an indirect collaboration between player and system creator. This indirect collaboration can be difficult to analyze, but story sampling helps reveal half of the story at least: that the system creators are happy with the output generated by the system's players. To learn the other half—that players feel a connection or collaboration with the system's designers (and not just the system itself)—will require techniques of its own, and remains future work.

Story sampling depends on discovering and finding potentially noteworthy player play traces to analyze. The next system we'll discuss is a means to discover such traces, and has already been used in the context of *Prom Week*.

6.2 Gamalyzer

As the previous section hopefully made clear, it is difficult for a game designer to predict what will happen when their game is in players' hands. During the early phases of design, it is feasible for a designer to directly observe players and make changes accordingly; but as the number of players increases, this ad hoc analysis cannot scale.

Accordingly, the games research community and the games industry (motivated by design concerns as well as business requirements such as profitability and user retention) have invested substantial effort in gathering and analyzing game play data [62]. A natural artifact to examine is the play trace, a sequence of player actions corresponding to one play of the game.

As discussed above, many design questions for popular genres such as first-person shooters concern the game's spaces (and are thus amenable to techniques such as spatial heatmaps). Unfortunately, there are many genres such as the previously broached story games or puzzle games, where spatial superposition of game states is unhelpful, and there are many design questions which are difficult to answer just by looking at color densities. To avoid committing to particular features of a given game's states, Gamalyzer proposes that the difference between play traces is an effective general-purpose measurement which can be used to help answer a variety of design and player-modeling questions, such as:

- "Do players pursue diverse strategies?"
- "Are winning traces similar to each other?"

- “What are the outlier plays of this game?”
- “Is it possible to win without being at all similar to this canonical trace?”

There are many metrics for computing play trace similarity, both game-specific and game-independent. For example, n-gram counts of actions could be compared or the terminal states of those traces could be compared. These comparisons abstract over play traces: the former considers unordered sets of counts and the latter merges the whole sequence into a single state. Gamalyzer, developed by my friend and colleague Joe Osborn [194], is a metric which applies a variant of edit distance to compare play traces directly, without abstracting over time. While one can imagine several similarity metrics, one should (in theory) use the most correct one: that which agrees the best with the designer’s own perception of differences between play traces.

A previous paper has been published which evaluated the validity of Gamalyzer by comparing its distance measures of *Prom Week* traces to reported distances made by one of the game’s designers [195]. This paper both revealed insight into *Prom Week*, but also into Gamalyzer itself. As this chapter is meant to focus on tools and techniques to help evaluate pieces of interactive narrative, that paper’s findings on *Prom Week* are presented here, with only a modicum of evaluation of Gamalyzer itself, though both operate under the assumption that the better a metric agrees with human appraisals of difference, the more useful it will be in answering questions like the ones above.

6.2.1 About Gamalyzer

Gamalyzer is a variant of the constraint continuous edit distance applied to game play traces [194]. Briefly, it finds the cheapest way to turn one play trace into another using only matches, insertions, and deletions. The cost of matching a single game event (or input) to a different game event is defined by a recursion on the name and parameters of that event. This syntactic difference is interpreted as a semantic difference, because the encoding of play traces as sequences of parameterized game actions depends critically on design knowledge to determine the types and names of events, their parameters, et cetera.[3]

Gamalyzer assumes that play is goal-directed, that substantial differences in length indicate substantial semantic differences, that inputs arrive at roughly the same rate in every trace, and that events which are far apart in time are incomparable. This last assumption is the constraint in constraint continuous edit distance: a parameter called the warp window (ω) prevents match operations for pairs of inputs of each trace which are too far apart.

Gamalyzer encodings of game inputs consist of two main parts: a determinant and a value. If two inputs have different determinants, they are incomparable (their change cost is infinity); if their determinants match, then their values are compared recursively, with some parts of the value contributing more significantly to change cost than others. The determinants and value are sometimes called the parameters of an event, one of

[3]This distinction between syntactic and semantic differences is important! An example: the word "green" and the word "veridian" are syntactically quite different from each other as they are of different lengths and they share very few letters. Semantically, though, they both refer to similar colors.

which (generally the first parameter of the determinant) is the event type or name.

Gamalyzer, and in turn *Prom Week*, was evaluated with two different encodings of *Prom Week* play traces. As discussed in chapter 5, each move in *Prom Week* has the player select an initiating character, a social exchange, and a target character. In the first encoding ($\mathrm{glz}_{\mathrm{ie>t}}$), every input has the same determinant: the string "move" to signify that everything being measured is a social exchange, or in other words, a player's move. In this encoding, the social exchange's initiating character (i) has the same relevance as the combination of social exchange (e) and social intent (a social exchange category); and both of those have greater relevance than the target character (t). The second encoding ($\mathrm{glz}_{\mathrm{intent}}$) puts the intent into the determinant and treats the initiator, social exchange, and target as equally important.

These encodings carry different design knowledge. In the former, it is assumed that every input is roughly comparable; in the latter, pursuing different social goals—such improving friendship, beginning to date, becoming enemies—is treated as making fundamentally different maneuvers. If one encoding performs better than the other in creating play trace dissimiliarity comparisons that match the *Prom Week* designers' perception of dissimilarity, that says something about *Prom Week*: either social intent is one component of strategy among many, or else it is the primary indicator of player intention.

For a concrete example of each encoding, consider a turn in which the player wants Chloe to flirt with Doug. Here, the initiator is Chloe, the target character is Doug, the social intent is to increase Doug's romantic affection for Chloe, and the specific social exchange is flirting. In the $\mathrm{glz}_{\mathrm{ie>t}}$ encoding, the input's determinant is simply *move* and the value contains Chloe, Flirt, and Doug, with Doug in a less-important position; in the $\mathrm{glz}_{\mathrm{intent}}$ encoding, the determinant is romanceUp and the value contains Chloe, Flirt, and Doug in equal prominence.

6.2.2 Applying Dissimilarity Metrics

Distance measures do have an immediate utility for searching and filtering play traces, but they can also be applied to other purposes. Here I consider one general purpose application—finding outlier play traces—and another which is of special interest to myself and the other designers of *Prom Week*: describing the overall uniqueness of a set of play traces. Armed with a sorted list of outlier traces, a designer could more easily recognize players who are misunderstanding a system, or who are playing to sabotage or circumvent it. To determine the degree to which each play trace is an outlier, we need an operational definition of "outlier-ness" in terms of distances between play traces.

My colleague Joe Osborn derived a measurement using k-medoids, a classical partitioning technique. The medoid of a set of traces is the trace with minimum average distance to all the other traces in the set; to generalize to k >1, we pick k elements (medoids) of the set so as to minimize the sum of the distances of each trace in the set to its nearest medoid. Informally, a medoid is like a centroid, except that it is not a mean, but a median (one of the elements in the original set). To calculate the degree to which a trace is an outlier with respect to a set of traces that contains it, we take its distance from the nearest medoid.

This approach is used to judge the overall uniqueness of traces in a set: to a first approximation, it can be imagined that the average outlier rating of the traces in the set is a proxy for the set's overall uniqueness. For sets where many traces are strong outliers, the uniqueness will be high, and for sets with few strong outliers, the uniqueness will be low.

6.2.3 Gamalyzer Evaluation Experiment Design

In an experiment designed to evaluate the validity of Gamalyzer, a *Prom Week* designer[4] was given transcripts of play traces (similarly to what was described in chapter 6.1) and asked to rank how similar they were to each other with respect to specific considerations, described in more detail below. These similarity scores determined by the designer were taken as a ground truth, against which several other dissimilarity metrics—namely, the two aforementioned gamalyzer metrics and three other basline metrics—were compared. The closer the other metrics scored to the human designer, the more accurate each was interpreted to be. Several of the distance metrics involved parameters which had to be tuned (Gamalyzer's warp window ω; k=1 or 2 medoids; and n for the n-gram metric). In each case, an automated search process was used to select parameter values that minimized root-mean-square error so that each metric (including the baselines) would be represented as well as possible. The complete experimental setup including play traces, ratings, and analysis code are available at my colleague's website: https://github.com/JoeOsborn/metric-eval.

[4]The designer in question was actually myself, but in the interest of keeping the methodology generalized, I will continue to refer to my role, rather than speak in the first person

The experiment's samples were drawn from the 3,186 complete play traces of a specific campaign of *Prom Week*: Doug's story. To reach this point players must have built up a basic proficiency of manipulating the social space. Additionally, though Doug's scenario has multiple solutions to its social puzzles, its short length makes the designer's task of providing dissimilarity ratings tenable. Future work must examine whether some metrics are more or less appropriate in other levels of *Prom Week.* Individual traces consisting of a sequence of moves instigated by the player (an interactor, a social exchange, and a target character) were presented to raters as prose generated by a simple templating system which presented the characters involved and the intent of the social exchange.

Each of the ratings questions includes the language "with respect to player strategy." This is because play traces could be dissimilar in a variety of ways: with respect to player strategy, player experience, winning or losing, goals achieved, et cetera. The questions were framed so that the rater would consider only the lens of player strategy (which seems the likeliest sort of similarity to derive using only player actions). By using three sets of rankings in three experiments, the accuracy of the metrics under test are demonstrated in answering a range of common game-design questions, giving a better sense of their overall utility. Here, player strategy can be thought of us a particular type of authorship: the player has a goal that they are attempting to achieve, how they succeeded—or failed—to achieve it is the story they created.

The main concern in all three experiments is the low number of ratings relative to the population of traces. This is somewhat unavoidable, since most games have a small number of designers and a large number of play traces; it would be extremely difficult for so few people to annotate so many traces. Another issue compounded by the small number of raters is that a single rater might use different heuristics and internal criteria during different trials. More raters could control for this; as it is, it must be assumed that the designers have a good sense of play trace difference. For future utilization of this or similar techniques with similarly few raters, possible controls include "warming up" each rater with several trials whose ratings will be discarded, or randomizing the order of the trials for each experience.

6.2.3.1 Experiment 1: Trace Dissimilarity

The fundamental question when evaluating a play trace dissimilarity metric is whether the metric is accurate. The natural experiment, then, is to compare the distances provided by some candidate metric against human-provided distances. For this experiment, 25 trials of the following scenario were conducted: a sample of six traces were randomly selected from the population, the first of which was designated as a reference; then, a distance was determined from the reference to each of the other five traces. Raters evaluated each trace's distance from the reference on a 7-point Likert scale by being asked the following question: "on a scale of 1 to 7, with 1 meaning 'exactly the same' and 7 meaning 'incomparably different', how different is this trace from the reference trace with respect to player strategy?" The ratings were normalized to a closed unit interval and compared against each of the distance metrics.

6.2.3.2 Experiment 2: Outlier Rating

The second experiment meant to determine whether the Gamalyzer metric was the best choice of distance metric for outlier rating. It therefore needed designer ratings which described how much the designer perceived a given trace to be an outlier among a given set of traces. For this experimented 25 trials were conducted in which 10 traces were randomly selected from the population. In this case, there was no reference trace; each trace was to be rated in terms of its "fit" with the rest of the sample. Raters determined this fit for each trace on a 7-point Likert scale ("On a scale of 1 to 7, with 1 meaning 'completely typical' and 7 meaning 'completely atypical', to what extent is this trace typical of this set with respect to player strategy?"). These ratings were normalized to a closed unit interval and compared against the outlier rating measurement described above, using each of the underlying distance metrics.

6.2.3.3 Experiment 3: Overall Uniqueness

Finally, and perhaps most directly related to the goal of shared authorship, I hoped to learn more about a core question underlying the evaluation of *Prom Week* as an interactive social AI system: Do players have unique experiences with the game? While the "player strategy" framing alters the tenor of this question somewhat, it can be supposed that a player's choices are determined in large part by the player's experience of the game, and that their experience is also influenced by their choices. For this experiment, 25 trials were conducted in which 10 traces were randomly selected from the population. This experiment also used no reference trace. Raters were asked to describe the whole set of 10 traces in terms of its incoherence—how unique or "spread out" the plays in this set were ("On a scale of 1 to 7, with 1 meaning 'completely uniform' and 7 meaning 'not at all similar', how similar are the traces in this set with respect to player strategy?"). These ratings were normalized to a closed unit interval and compared against the uniqueness rating measurement described above, using each of the underlying distance metrics.

	Dissimilarity	Outliers	Uniqueness
$\mathbf{glz_{intent}}$	0.208	0.279	0.189
Interactions	0.219	0.292.	0.173
1-grams	0.236	0.304	0.242
$\mathbf{glz_{ie>t}}$	0.287	0.326	0.290
States	0.592	0.557	0.576

Table 6.1: Root-mean-square error results for all play trace dissimilarity metrics. The column headers represent the three different experiments. The row headers are the five different dissimilarity metrics used.

6.2.4 Gamalyzer Results and Discussion

Table 6.1 shows the root-mean-square error obtained between each of the five dissimilarity metrics and the game designer's ratings—the assumed ground truth—for each of the three experiments. The results seem to strongly indicate that both encodings of Gamalyzer fared substantially better than a state based metric (i.e., that the specific paths used to reach a certain game state is an important differentiation, rather than simply only looking at the state itself). One major takeaway is that, while one Gamalyzer encoding was superior to the three baseline metrics, the other Gamalyzer encoding performed worse. Though clearly sensitive to the format of the input encoding, the fact that Gamalyzer can outperform other metrics is promising for its more widespread use as a game independent dissimilarity metric. But why did these metrics rank in this order? Answering this question could lead to new insights about *Prom Week*, as well as potentially improvements in Gamalyzer.

The trace dissimilarity experiment gives a foundational measure of suitability for a play trace distance metric. $\mathrm{glz}_{\mathrm{intent}}$ (with ω=20, the highest value possible for these experiments) narrowly edges out the interaction count metric and n-gram counting (n=1), but all three have error within two scale points of the human ratings. $\mathrm{glz}_{\mathrm{ie>t}}$ (ω=7) fares slightly worse, while state distance performs badly.

The poor performance of state similarity might be because states describe outcomes and not strategies; the mean error of the state similarity metric is near -0.5, grossly underestimating dissimilarities (mean error is within 0.1 for all other metrics). This behavior is consistent with two observations: many distinct sequences of actions might lead to similar states; and many similar sequences of actions might lead to different states (due to the hidden information and highly emergent dynamics of the game rules).

Interaction counting likely beats n-gram counting by considering both the initiator and target of actions, and $\mathrm{glz}_{\mathrm{intent}}$ improves over the interaction counting metric by accepting fuzzier matches and considering temporal ordering more strongly. But how do the event counting metrics get so close even though they consider much less information? There must be temporal symmetries in the designers' perception of play trace differences. This came as a surprise to the designer who provided the ratings, although it is unclear whether these symmetries are actually embedded in the game's dynamics or merely emerge from the designer's ratings. In the future, comparing perceived trace dissimilarities versus actual state dissimilarities could be used to help validate a game design.

N-gram counting performs only a little bit worse than interaction counting; why? It seems that within a given level (or at least within the scenario observed), the social exchange or social intent almost completely determines on its own the two agents involved. This is not to say that players do not have options; but once they have selected a social exchange, there is generally a small number of reasonable choices for the initiator and the target. This was a concern to one of the game's designers: was it possible that the opening narration of that scenario guided players too strongly? In other games or in other *Prom Week* levels (perhaps in a level with a variety of potential romantic interests), this determination might not hold. If the difference in error between n-gram counting and interaction counting did not increase in such levels, that would support the claim that *Prom Week* moves are largely determined by social exchange selection.

Though this is a surprising result, it thankfully does little to dispel the findings outlined in chapter 5.3.2, or figure 5.5. That is because that the traces outlined in that figure were—for space concerns—already only looking at social exchanges played, and ignoring the specifics of the characters involved in them. My fellow designers and myself confess that we were under the impression that further breaking each node in that figure apart by character involvement would make the tree even wider—consequently revealing even more branches, and thus speaking even more definitively to players being able to shape their own unique narratives, further exalting *Prom Week* as a piece of shared authorship—but we opted not to in the interest of readability. This insight afforded by Gamalyzer reveals that such a break down would likely not expand the tree as meaningfully as originally though and, crucially, why that would be the case. As it stands, even with this contradiction in the designer's perception of their system, it appears that Prom Week's capacity for producing unique play traces (one of its central claims to shared authorship) remains untarnished. This does illustrate though the value of analysis techniques such as these, however; these systems are difficult even for its designers to accurately understand, and certain insights can only be garnered through novel techniques such as this.

The substantial difference in performance between the two Gamalyzer encodings (and the good performance of the two counting metrics) shows that, although Gamalyzer is game-independent, the best choice of encoding varies from game to game. Gamalyzer encodings seem to perform better when the determinant (the type of the event) discriminates strongly in the same ways a designer would discriminate; otherwise, unrelated events will be perceived as more similar than they ought to be. In *Prom Week*, it appears that the strategic part of the move is the intent, that is, a begin dating move is so strongly different from a become better friends move that they cannot be compared directly. There is also a sizable difference in optimal warp window between the two encodings. The large warp window in $\text{glz}_{\text{intent}}$ reflects the low temporal coherence required for designers to perceive similarity, while the smaller warp window in $\text{glz}_{\text{ie>t}}$ is necessary to avoid underestimating dissimilarity; the interaction between game design, encoding, and warp window width is worth exploring in more detail.

6.2.5 Gamalyzer Closing Thoughts

The main focus of this section was a methodology for evaluating play trace dissimilarity metrics, grounded in well established techniques for evaluating other types of similarity measurements. In this experiment, two encodings of Gamalyzer were compared against three standard dissimilarity metrics; one state-centric measure and two action-centric measures. Both encodings performed better than the state-based metric, while only one encoding performed better than the counting-based metrics. It seems that this technique is widely applicable to other games and other metrics. Other operational definitions of play trace characteristics—questions that a good metric should help answer—could also be included in this instrument as appropriate to the game under consideration.

This work also builds evidence for Gamalyzer's claim of game-independent dissimilarity measurement, but future work must repeat these experiments on other games and against other baselines. Gamalyzer does seem to yield relatively accurate play trace dissimilarities, and it can be used effectively in derived measures. That said, it remains highly sensitive to the choice of input encoding, and the findings presented here do imply that certain encodings lend themselves better to certain games. It is also likely the case that other design perspectives besides "player strategy" would be better served with specialized encodings. The space of reasonable encodings is relatively small for a given game, so it is feasible to find the best encoding through experimentation; but it would still be helpful to know more about the interaction between the game design and choice of encoding.

In order to be appropriate for broader use, Gamalyzer's documentation must provide clearer guidelines on what makes an effective encoding; moreover, tools should be developed that can guess at an encoding's quality based on properties like the number of parameters in each event, the number of distinct determinant types, and so on. As Gamalyzer matures and is used (and validated) in more games, the characteristics of good and bad Gamalyzer encodings will become more apparent, allowing us to provide more guidance about playtrace encodings to future Gamalyzer users.

If a game-independent play trace dissimilarity metric can be strongly validated against the intuition of professional game designers, new categories of general game design support tools will be possible. This will involve answering questions such as "Which metrics (or families of metrics) are most effective for which games?" The idea that some metrics are better or worse for certain games is also fascinating: if this is due to hidden properties of a given game's design or dynamics, the appropriateness of a metric might be used as a proxy for those hard-to-measure properties and evolve our understanding of the science of game design.

In short, Gamalyzer is still a work in progress, with many avenues for enhancement and extension. However, even in its current form, it was able to hint at truths about *Prom Week* that the designers themselves were unable to perceive without Gamalyzer's assistance. Whereas story sampling provided a means for system designers to evaluate the quality of player produced artifacts, Gamalyzer helped designers better understand at a structural level the avenues players actually have available to them through play. In other words, while story sampling revealed qualities of Prom Week's written instantiations and their selection process, Gamalyzer revealed the impact Prom Week's microtheories and social influence rules have on the possible paths players can carve out through the story space. Tools such as Gamalyzer provide a useful lens to view not just the finished product of the story, but the possible processes player's have in producing their stories; a valuable tool for the cause of shared authorship, given that it concerns itself with the process of story generation at least as much as it does with the finished product.

I'll now move on to a third tool, Playspecs, to further discover and analyze extraordinary player traces.

6.3 Playspecs

The motivation of Playspecs[5] proves to be the third verse to the song which is Chapter 6: game design produces complex emergent behaviors. Unfortunately, some of those behaviors may be undesirable, and some desirable behaviors may be absent: the design may not match the designer's intent. Furthermore, game programs do not always faithfully implement game designs. Techniques from the formal software verification community could help resolve both of these problems, but game designs are not always explicitly specified; even when specifications are explicit, they tend to be informal.

Informal or missing specifications require frequent playtesting and human interpreta-

[5] A system again conceived and developed by my friend and colleague Joe Osborn

tion to determine desirable or undesirable behaviors. Formal game modeling approaches like BIPED [269] automate some of this design verification, but often require a comprehensive logical model of the game design to operate. This can be challenging for game designers and programmers unfamiliar with formal logic. Even familiar tools like unit or functional tests have limited utility for checking the correctness of game programs: gameplay situations are complex to configure and correctness criteria often involve the evolution of game state over time. Automated testing of complex game functionality seems relatively uncommon in the game industry, as presentations at its flagship conference still advocate for it [59, 208]. Looking only at the behavior of games (rather than their code), most game play trace analysis uses aggregated metrics like event counts to collapse sequences of game states into sets of numbers [62]. Some work has also been done in searching for traces which contain certain events, in some cases only when prior to other events. Trace visualization and gestalt approaches [129, 194] are more prevalent than targeted queries; this may be because writing targeted queries is difficult, often combining multiple database lookups with code in a general-purpose programming language.

The following describes Playspecs, a formalism that cleans up and regularizes all of these trace analysis activities. Playspecs provides one play trace specification language (tailored for efficiently searching through play traces) that can be reused across different games. This language also scales up from trace filtering through to rigorous formal verification, permitting the use of the software engineering community's verification tools.

The input to these Playspecs can be play traces gathered from telemetry (or random play, or solution search) or a logical model of a game. Playspecs can be adopted at the level of the game engine or the individual game, and with a little developer effort they can be relatively natural for designers to author directly. Formally, Playspecs are ω-regular expressions over program states (instead of characters in a string); ω-regexes are a well-understood language for specifying the behavior of computational systems [5]. Playspecs contribute: an application of proven techniques from formal verification to game design; a specification tool with a scalable degree of formality; and an emphasis on the use of game- and game-engine-specific concepts and syntax when specifying a game design.

Like Gamalyzer, Playspecs was developed by my colleague Joe Osborn, who has applied a subset of the Playspec language to PuzzleScript [121], a game engine for designing puzzle games, to verify that level solutions are valid with respect to a designer's intent. Source code is available on GitHub in the js/analyzer/ directory of https://github.com/joeosborn/puzzlescript/tree/analyzer (though this particular user case implements an earlier draft of Playspecs). Given their promise in this relatively general application, Playspecs have begun to be applied to the analysis of play traces from *Prom Week*, which is what I will focus my discussion on in this chapter. A relatively complete, efficient, and documented reference implementation used in for the *Prom Week* analysis can be found at https: //github.com/joeosborn/playspecs-js (though again, Playspecs has been evolving since the time these experiments were conducted).

Alright, let us get to it. First, we'll motivate the use of Playspecs with Puzzle-

Script and *Prom Week* examples. I'll then formally define the syntax and semantics of Playspecs for an audience that may be unfamiliar with existing work in program verification. Finally, I'll outline how to apply Playspecs to existing games and game engines.

6.3.1 Motivating Examples

PuzzleScript has already received some attention from the game AI community [125]. It offers a semi-declarative syntax for defining 2D puzzle games in terms of 1-dimensional rewrite rules which each match a slice of the current game level (a 2D grid of objects, where multiple objects may reside at the same position) and modify that slice according to a fixed pattern. For example, to detect a player object moving towards an adjacent box object (in any direction), one writes `[> Player | Box]`; to cause the box to move under this circumstance, the complete rule is `[> Player | Box] -> [> Player | > Box]` (note the >arrow which is added to the box on the right hand side). Levels are written out as 2D grids of ASCII characters whose meanings are assigned by a legend. Each level is won when the game's win conditions, e.g. all Box on Target, are met.

In puzzle games, it is important to gradually present the game's concepts to the player, building up to more complex problems. If a player can complete a stage without learning a necessary concept (for example due to an oversight in the level design) they may be unprepared for future levels. The designers of the math puzzle game *Refraction* invented means to detect and prevent these kinds of design bugs [267], but applying their techniques to new games requires working largely from scratch.

Playspec	**ω-Regex**	**Explanation**
`P`	`p`	The fact `p` holds in the current state
`P&Q`		`P` and `Q` both hold in current state
`P|Q`	`[pq]`	Either `P` or `Q` holds in current state
`not P`	`[^P]`	`P` does not hold in the current state
`F,G`	`FG`	Sequence `F` and then `G`
`F;G`	`F|G`	Either sequence `F` or `G` hold
`F^G`		Sequences `F` and `G` hold
`...`	`.*`	Matches any number of states
`F ...`	`F*`	F matches any number of states
`F 1. . .`	`F+`	F matches one or more states
`F M...N`	`F(M,N)`	F matches between `M` and `N` states
`..`	`.*?`	Reluctantly matches any number of states; same variations as `...`
`F***`	F^ω	`F` repeats forever

Table 6.2: Playspec and analogous ω-regex syntax.

As has been shown many times over by this point, *Prom Week*'s myriad social rules, social exchanges, and retargetable instantiations lead to a vast amount of emergence and dynamism. This rich dynamism comes at the cost of predictability: though adding additional rules is important for making characters believable, it is difficult to anticipate how any given rule affects the rest of the system.

There are three main applications of Playspecs to *Prom Week*: finding traces with interesting or surprising behavior or strategies; verifying that level-specific goals can still be met when influence rules are changed or added; and identifying traces as unbelievable if characters perform unrealistic actions like repeatedly breaking up and starting to date again on successive turns. Playspecs can reason over the same social facts as the influence rules do with a custom syntax resembling labeled edges. For example, `Doug-friends-Jordan` checks whether Doug and Jordan have the friends relationship, and `Doug-romance<0.3-Chloe` succeeds if the value of Doug's romance network for Chloe is less than 0.3.

6.3.2 Playspecs

As I discussed in 6.2, a play trace is a sequence of data generated by activity in a game. The simplest possible play trace might be a log of the inputs provided by the user. Richer traces carry more data: more abstract inputs and events, more elements of the game state, and so on. These traces might be physical files stored on disk or may be generated on the fly by a verification tool. In *Prom Week*, traces contain individual social exchanges and their outcomes; they come from either observed game play (gathered by telemetry) or from exhaustive enumeration of games up to a fixed number of turns. Playspecs assume that game traces are *sequences of sets of facts*.

Prom Week Examples
`Doug-romance<0.3-Chloe ...  ^ not Doug-dating-Chloe 1..., Doug-dating-Chloe` With a romance network value of less than 0.3 the entire time, Doug must go from not dating to dating Chloe.
`Doug-dating-Chloe, ..., not Doug-dating-Chloe, ..., Doug-dating-Jordan & Doug-friends-Chloe` Doug begins by dating Chloe, but they eventually break up. Doug begins dating Jordan and befriends his old flame.
`Doug-friends-Chloe, ..., Doug-dating-Chloe ; Doug-dating-Chloe, ..., Doug-friends-Chloe` Doug befriends Chloe and then starts dating her, or else Doug starts dating Chloe before they become friends.

Table 6.3: Example Prom Week playspecs

A Playspec *matches* a trace in the same way that a regular expression matches a string. One regex might match several distinct positions in the string or use start and end anchors to only match complete strings; analogously, a Playspec may match a portion of a play trace or an entire trace. Just as a regex describes a set of possible strings (a *language*), each Playspec describes a set of possible traces.

A regex checks whether each character in the string is a member of a particular set of characters, but Playspecs support a variety of complex (often game- or game-engine-specific) queries on individual states. Boolean combinations of these game-specific basic facts make up the state language fragment of Playspecs, and the game-independent syntax for describing the evolution of states over time is the trace (or regular) language fragment (Table 6.2 describes both fragments in a side by side comparison of Playspec and ω-regex syntax).

There are four basic facts which are the same across all games: `true`, `false`, `start`, and `end`. The first two are self-explanatory; the third and fourth indicate the beginning and end of the play trace respectively (roughly analogous to regex ˆ and $ anchors). Note that while the propositional formulae of the state language can be negated, the temporal sequences of the trace language may not be.

All other basic facts are game- or genre-specific. Some facts could be provided by general-purpose game engines; there is also a connection to the authorial affordances of operational logics and domain models [145, 193], which are portable across game genres.

When considering a sequence of states in Playspecs, the fundamental requirement is a way to advance (or consume) the current state. Regular expressions implicitly advance the stream of characters: `abc` means an `a` followed by a `b` followed by a `c`. This can also be read as the regex `a` followed by the regex `bc`. This is called concatenation. Playspecs have more complex syntax for each individual state so a comma (,) is used to indicate concatenation; it could be read as *and then* or *followed by.* A simple example using *Prom Week*: the Playspec `Doug-mean-Chloe, Doug-guilty, Doug-nice-Chloe` would only match traces in which the player had Doug do something mean to Chloe, then made him feel guilty[6], and then had him be nice to her. Each of these three basic facts is checked in turn against successive positions of the trace.

A designer doesn't always know in advance how long a property should hold. For instance, a designer might want to find traces where two characters begin dating but eventually break up. This is analogous in regex to asking for a lowercase letter eventually followed by a number using the Kleene star (`[a-z].*[0-9]`); there can be any number of characters between our two points of interest (the letter and the number), just as any sequence of game states or player actions may transpire between the characters falling in and out of love. In Playspecs, this repetition might be written as `Doug-dating-Chloe 1..., not Doug-dating-Chloe`. The use of `...` is read as dating until no longer dating (the preceding numeral `1` requires that the characters are dating for at least one state). The ellipses describe potentially multiple states in which a property holds (`Doug-dating-Chloe` in the example), with true as a default. `...` is also greedy: it will prefer to consume as many states as possible when matching. The `..` variants (note how it is only two dots!) consume as few states as possible. When there are multiple matches, these operators will yield all the same matches in opposite order. Minimum and maximum bounds can also be provided (as in `1...`), and these default to 0 and infinity.

[6]As discussed in chapter 5, the player interacts with the system by having characters engage in social exchanges with one another. So though the player can have Doug directly take actions generally recognized to be "mean" or "nice" towards Chloe—say insulting her or praising her, respectively—the player does not *make* Doug feel guilty directly. That is, there is no "feel guilty" action. Instead, the player might have another character chide Doug for his insult, which could have the effect of leaving Doug feeling guilty for his actions; that sense of guilt would enter the social facts database, where it could then be used to match a Playspec.

Original Trace	Sequence of Sets of Facts
<SocialGameContext	time = 1,
gameName='Share Interest'	doug-!share_int(8, 'phone')-jordan,
initiator='Doug'	chloe-cool=0.7-doug,
responder='Jordan'	chloe-romance=0.8-doug,
effectID='8'	chloe-friend=0.5-doug,
chosenItemCKB='retro phone'/>	...
<SocialGameContext	time = 2,
gameName='Pick-Up Line'	chloe-!pick_up_line(6)-doug,
initiator='Chloe'	chloe-funny-doug,
responder='Doug'	chloe-romantic-doug,
effectID='6'>	chloe-cool=0.7-doug,
<SFDBLabel type='funny'	chloe-romance=0.9-doug,
from='Chloe' to='Doug'/>	chloe-friend=0.6-doug,
<SFDBLabel type='romantic'	...
from='Chloe' to='Doug'/>	
</SocialGameContext>	
...	...
<SocialGameContext	time = 16,
gameName='Reminisce'	doug-!reminisce(8, jordan)-chloe,
initiator='Doug'	...
responder='Chloe'	
effectID='8'	
other='Jordan'/>	

Table 6.4: Play trace data from *Prom Week*. The left column illustrates how play traces are recorded, while the right shows (abstractly) the information made available for Playspecs to query at each timestep. This particular trace tells a story about the character Doug sharing an interest in retro phones with the character Jordan, being asked out by Chloe, and then much later reminiscing with Chloe about Jordan.

The regex notion of *alternation* can be used to discover if at least one of several Playspecs holds. One can look for either an `a` followed by a `b` or else `xyz` using the regex `ab|xyz`. To avoid ambiguity with the state language's propositional disjunction `|`, and for symmetry with the `,` of concatenation, Playspecs use `;` for alternation. Continuing with the dating example, one might want traces where Doug ends up single, i.e., he breaks up with whoever he dates or else never dates in the first place. The Playspec `not Doug-dating-Chloe ...; Doug-dating-Chloe 1...,` `not Dougdating-Chloe` matches when Doug never dates Chloe or they date before eventually breaking up, but doesn't account for Doug and Chloe resuming their relationship and staying together afterwards. By applying the repetition operator to that whole specification, one can match only traces in which Doug never lives happily ever after: `start, (not Doug-dating-Chloe... ; Doug-dating-Chloe 1...` `, not Doug-dating-Chloe)... , end`.

Note that the number of states consumed by the alternation depends on the branch that matched. A Playspec like: `Doug-lonely, (Doug-dating-Chloe;` `Doug-friends-Oswald, Doug-friends-Jordan), not Doug-lonely` consumes either three or four states: either Doug is lonely, Doug starts dating Chloe, and then Doug loses the lonely status (3 states consumed) or Doug is lonely, Doug becomes friends with Oswald and Jordan, and then loses the lonely status (4 states consumed). Alternation can be understood as cloning the expression once for each operand (i.e., either side of the `;`), replacing the expression with each of the operands, and succeeding if any of these clones match.

As a notational convenience, Playspecs includes `^`, read as *and* or *intersection*, which is dual to `;`. Like `;`, it effectively clones the Playspec for each operand. Unlike `;`, all clones must match the same portion of the trace for the match as a whole to succeed. For simplicity Playspecs requires that all operands consume the same fixed number of states or that they can be stretched via `...` to fit the same segment of trace. Formally, this is the intersection of languages: a grammar which only matches strings that appear in both languages. This syntax can be used to find play traces where multiple paths leading to a single state must contain certain events or state sequences. Suppose one wants to know when Doug becomes enemies with his former friend and lover, regardless of whether their initial relationship was platonic or romantic: `(..., Doug-friends-Chloe, ...   ..., Doug-dating-Chloe, ...), Doug-enemies-Chloe`. While regex libraries in most programming languages do not offer intersection, Playspecs includes it, in part to help define universal quantification (an extension left for future work). Further examples of the Playspec syntax described thus far can be found in Table 6.3.

So far, the syntax only recognizes play traces of finite length. While not applicable for matching existing traces, Playspecs which specify traces of infinite length can be useful for verifying game designs. Checking for infinite loops can detect cases where players get stuck, which would only show up as quitting in a real trace. To forbid such infinite traces, Playspecs must be able to describe them. It is therefore assumed by default that Playspecs recognizes finite portions of traces, but a syntax in introduced for recognizing an infinite suffix which satisfies a Playspec repeatedly. The forever operator (called ω in ω-regex) is written with `***`: it is a semantically and visually lifted version of `...` indicating that the Playspec it modifies repeats forever. It may only appear at the end of a Playspec, and it will not match any finite play trace. Unlike `...`, it accepts no time-bounding arguments.

6.3.3 Integration with Existing Games

There are two main decisions when integrating Playspecs with an existing game or game engine: the degree of formality and the content of traces. For *Prom Week*, Playspecs is used to filter and match existing play traces; this requires the least effort but is also the least flexible. Alternative solutions include what has been done with PuzzleScript: generate puzzle solutions using heuristic search and then test those solutions against Playspecs; this requires few modifications to the underlying game engine, but exhaustively checking solutions has a high computational cost. Formally modeling the game under consideration would require extra authoring effort but could answer targeted queries very quickly.

The first step towards integrating Playspecs is transforming the game's play traces into sequences of sets of facts. This could involve modifying how traces are recorded, converting traces in an external tool, or performing on-demand translation into this format. In PuzzleScript the process starts with a sequence of input directions which are replayed through the game engine to recover the configuration of the level at each step. Playspecs are written over these augmented traces. A game with more complex state might define each set of facts implicitly via a function that determines the truth of a proposition.

Table 6.4 shows examples of *Prom Week* play traces both in a game-native format and after augmentation with extra state data from resimulating the recorded input sequence. The concrete syntax shown is only for illustration.

As for what comprises a trace, there are three important factors. First is the trace's level of abstraction: the game activity represented in the trace. A trace might contain frame-by-frame or turn-by-turn game states or abstract level-by-level progression. Frame-by-frame traces will be too fine-grained for most use cases besides the unit-testing application.

Second is whether the trace contains instantaneous events, durative states, or both. Using only game events will yield more compact traces, but some specifications may be harder to write; on the other hand, traces with only states may make other Playspecs awkward. Including both (or recovering states by replaying inputs) can be a good option.

Finally, the implementer must decide on a syntax for game specific basic facts. These often use tokens and syntactic structures outside of the existing Playspec grammar, for example *Prom Week*'s relationship tests. Parsing and checking these predicates is necessarily implementation-dependent, but a portable grammar formalism could potentially cover most use cases; the JavaScript reference implementation instead provides a customizable parser. One could also imagine a generic fact syntax.

The application of Playspecs to *Prom Week*, or any piece of shared authorship, remains purely theoretical. Thus, though there are yet to be any specific insights gained about *Prom Week* through the use of Playspecs, the next section will discuss how Playspecs could be used to achieve valuable knowledge about the types of stories the game allows players to produce. I also discusses potential applications for how Playspecs might be integrated into Prom Week at run time to further augment the authorial voice of Prom Week itself, a valuable contribution to shared authorship and an application we'll see repeated in our discussion of an in-progress prototype in chapter 8.

6.3.4 Closing Thoughts on Playspecs

And thus ends a description of Playspecs, motivations for their use, and ways to integrate them into existing games and game engines.

Hopefully game developers—especially game engine developers—adopt Playspecs at least at the level of matching and selecting existing or randomly generated traces, and ideally that they offer ways to drive their game engines via Playspecs. I further hope that game researchers will consider Playspecs as their language of choice for specifying properties of interest for formal models of games. As a language for defining the evolution of game states over time, Playspecs could undergird a rigorous study of game dynamics in the sense used by the MDA framework [103], which are so far under-theorized compared to game mechanics and aesthetics. Playspecs could be applied to AI play by running them backwards, generating rather than recognizing traces (as in the use of linear temporal logic in the planning community [8]). Playspecs (perhaps with fuzzy or probabilistic extensions) might also have applications for general game playing, particularly in opponent modeling or characterizing sets of play traces produced by random or self-play. They could also be used in generative systems to filter out generated content that violates designer-specified invariants.

All of these applications help ensure that the actual game design is in line with author's intent, and can reveal otherwise hard to discover insights about player behavior.

But Playspecs can be employed to help drive game engine decisions as well. In *Prom Week*, there aren't any systems in place to recognize the 'type' of story that is being told; characters determine their actions based on the social state—so characters are always behaving believably (more or less)—but there's nothing guaranteeing that the story being produced is dramatically interesting. Playspecs could be applied as a recognizer to see if the actions and states generated thus far in a play through of the game adhere to any number of story archetypes and, if so, could influence the game engine to try to make the rest of the archetype more likely to pan out.

An example of a "sad" *Prom Week* story, easily implementable in Playspecs, might be that two characters that start off with opposite feelings of romance towards each other (i.e., a situation of unrequited love) gradually exchange their opinions of each other (i.e., the scorned turns into the recipient of the other's affections, though they are now no longer interested). This might be captured as a Playspec as:

```
start Doug-romance<0.3-Chloe & Chloe-romance>0.7-Doug,
...,
Doug-romance>0.7-Chloe & Chloe-romance<0.3-Doug end
```

That is, Doug begins by not being interested in Chloe, who is infatuated with him, but by the end their feelings have reversed. If connected to the engine, when the system catches wind of Doug and Chloe having this starting relationship, it could affect the existing influence rules—or create new ones—that would encourage Doug and Chloe to take actions which would lead to them both having lukewarm feelings for each other, until eventually Doug is interested in Chloe who no longer cares about him.

In short, Playspecs could be a means of augmenting *Prom Week's* dynamic character-centric social simulation with the satisfaction that comes from well structured stories. Note that this is not currently implemented in *Prom Week*, but is an exciting potential application of Playspecs for future work. Additionally, another system currently under development (described in chapter 8) plans to leverage Playspecs in a manner very similar to this.

6.4 Conclusion

And thus we've reached the conclusion not only of Chapter 6, but also the first complete "loop" of discussing an underlying AI system (e.g., CiF and Ensemble), the playable experience it enables (e.g., *Prom Week*), and mechanisms to analyze certain qualities of the artifacts the playable experience is capable of producing, and the process of play through which they are produced from an authorial perspective (e.g., story sampling, Gamalyzer, and Playspecs). By using these techniques, me and my fellow designers of *Prom Week* were able to glean valuable insights about the game that would be otherwise difficult to ascertain, including that the technique of retargeting social exchanges based on social context—one of the primary mechanisms *Prom Week* leveraged to lessen authorial burden—was capable of capturing a variety of nuanced interpretations based on the social context produced by players while confirming the relative low presence of undesirable repetition of text and, crucially, providing insights into what specifically makes text repetition undesirable in the specific context of *Prom Week*). Gamalyzer provided a deeper understanding of the results presented in chapter 5.3.2, revealing a misconception on the part of the designers, but thankfully not contradicting (and in so doing, corroborating) the designers belief that *Prom Week* provides extremely diverse play traces and a unique experience for every player; a central tenet of shared authorship. And though Playspecs was not directly applied towards *Prom Week*, it is hopefully clear to the reader how its use on—or even integration within—interactive narrative experiences could help evaluate and produce works of shared authorship. Though these techniques have value in being applied to any work of interactive storytelling, they are particularly valuable in revealing insights about systems that leverage procedurally generated or otherwise emergent narrative; as shared authorship must make use of such narrative systems to permit players to create their own stories, their specific application in a shared authorship domain seems a natural one.

Now that we are experts at this loop, let us repeat the cycle once more (blessedly with somewhat more brevity) to describe another experiment in shared authorship, and a game that intimately combines two of my greatest loves: deep simulation and improvisational performance. Gentle reader, the time has finally come for me to share with you a little bit of *Bad News*.

Chapter 7

Bad News

7.1 Introduction

This chapter is all about *Bad News*, an installation-based game that combines procedural generation, deep simulation, and live performance. Before I dive into a full description of the game itself[1], I will describe the underlying AI framework that powers the game, much as I described CiF before diving into *Prom Week*. The chapter will conclude with an analysis of how *Bad News* breaks new ground with regards to the notion of shared authorship, as well as examine ways in which it could be improved.

7.2 *Talk of the Town*

Bad News is built upon the *Talk of the Town* framework. A thorough description of *Talk of the Town* can be found in [239]. However, I shall briefly attempt to describe it

[1] A description which draws heavily from [250].

here for the reader's benefit.

In truth, the name *Talk of the Town* refers not to an AI system itself, but rather to an as-of-yet unimplemented playable experience meant to be powered by an unnamed AI framework. However, since *Talk of the Town* at present only exists at the design stage, and it's framework is very much so alive and real, I shall refer to the AI system itself as the *Talk of the Town* framework (and indeed, this has been the convention adopted in other publications about *Bad News* [238, 240]).

The *Talk of the Town* system was created as a remedy for playable experiences with omniscient characters (an issue that I have already discussed is present in *Prom Week* in chapter 5). The designers of *Talk of the Town* recognized that incomplete knowledge is a pivotal element of many narratives, ranging from Romeo being unaware that Juliet's death was in truth sleep in Shakespeare's classic tragedy to the eponymous star of *Little Red Riding Hood* not recognizing a wolf in grandmother's clothing. The authors also posit that it is not only important for characters to have partial knowledge of their world, but for memories themselves to be fallible, such as in the *The Count of Monte Cristo* or *Les Miserables*, both of which include characters that are forgotten by those who were once close to them due to the passage of time.

The framework, then, is a concerted effort to create and support characters with partial knowledge and memory fallibility: the system revolves around the idea of knowledge representation, generation, propagation, and deterioration. Characters in the framework have a mental model of the people, homes, and businesses around them. The information stored within the mental model differs depending on whether it refers to a person or a building; characters can recall other characters' names, appearances, occupations, places of residence, and their current whereabouts. Similarly, characters can accrue knowledge pertaining to a business' owner, block, address, and who lives or works there. In addition to holding beliefs about these things, characters recall what sources—or pieces of evidence in the system's parlance—led them to believe these things in the first place (be it through first hand observation, conversation with another individual, or eavesdropping on others), and the strength of their beliefs. This strength is determined not only by the amount of evidence supporting a particular belief, but the nature of where it came from; evidence provided by good friends is valued as more trustworthy than from strangers. It is important to note that the representation of characters' mental models closely mirrors the representation of the 'truth' of the simulation; this allows for any given belief to measured for accuracy against the simulation's reality.

As mentioned above, the origination, propagation, deterioration, and termination of knowledge are the key components of the system. Knowledge can originate in a variety of ways, including *reflection*—in which a character perceives something about themselves—and *observation*, in which a character perceives something about a character that is in the same location they are. Knowledge can originate through false or mistaken contexts as well. *Transference* describes the phenomena in which a character has two similar mental models for two separate entities, and thus may mistakenly take a belief for one of the entities and confusedly attribute it to the other. *Confabulation* occurs when a character unintentionally creates new knowledge that is simply incorrect. Conversely, a *lie* is when a character intentionally spreads misinformation (or, rather, information that they believe to be false). The lies themselves are based on a mixture of social science research [111], malice and anarchy; a character will decide if they wish to lie based on their affinity with their interlocuter, but once the decision to lie has been made, they will lie about a random belief with no additional motive than to sow chaos.

Characters propagate information to one another through *statements*; that is, if two characters are co-located, they may engage in conversation and swap beliefs with one another. Similarly, characters can *eavesdrop* on conversations, garnering the same knowledge. Over time, characters' beliefs will *mutate* (based on probabilities in a hand-authored lookup table), causing characters' beliefs to be slightly mistaken (e.g., mutating a correct belief of a character being blond to a false one of them being red-headed). Characters have a memory attribute which determines their capacity to remember and is inherited from their parents. Lastly, if enough time has passed and a character's memory attribute is low enough, beliefs can simply be forgotten altogether. Note how, even though holes in a character's memory might seem drastic, it is in fact less damaging to the collected knowledge of the town, as a character will honestly recognize the gap in their knowledge, as opposed to unintentionally spread lies they believe to be true.

Characters revise their beliefs as they gather additional evidence and, comically but realistically [318], as they themselves spread information. That is, as a character expresses a belief to others, that character becomes more firmly rooted in that belief. As characters are presented with beliefs that clash against their mental models, they remember the alternative as a *candidate belief*, along with the evidence that supported it. If enough pieces of evidence corroborate the candidate belief, it replaces the character's prior belief in the mental model, which in turn is relegated to candidate status. This way, though characters only have a single belief pertaining to any given fact at a time, they are simultaneously cognizant of other possibilities. I have already mentioned that a character is more likely to believe evidence coming from a trustworthy source, similarly, characters' likelihood of retaining information is determined through a computation of salience; who the belief is about impacts the probability of remembering (characters are more likely to remember facts about friends than strangers), as does the type of knowledge itself (for example, first names are much more salient than the chin shape a character has [220, 231]).

A system in which deception is commonplace, replete with characters which possess their own mental model of the world, might sound familiar from *Tale-Spin*, described in chapter 2.1.3. Indeed, *Talk of the Town* is not first piece to have characters dally with deception [38, 54] or possess their own mental models of the world [137, 259], and there are a few examples of work done with the aim of creating interactive narratives with perceptive characters [295, 84, 12, 24]. Perhaps the state of the art of this level of simulation is *Dwarf Fortress* [2], previously discussed in chapter 3.1. Tarn Adams, its creator, has revealed that *Dwarf Fortress* has a rumor system that is somewhat analogous to *Talk of the Town*'s knowledge propagation, and though characters can lie, it is primarily only in capacities that are seen by the player, and do not subsequently affect the simulation. Adams has toyed with the idea of memory fallibility, but is nervous that without skillful framing, it might appear to be a bug (and, consequently, an example of the *Tale-Spin* effect).

Thus, though inspired by others, *Talk of the Town* remains one of the first systems to support character knowledge propagation, and is perhaps the first multiagent system to implement a notion of memory fallibility. Adams' challenge still stands, however: is it possible to leverage this system into a game in which these features are recognized as shimmers of a complex system, and not misinterpreted as bugs? Though the originally proposed game of *Talk of the Town* might still be unimplemented, a different game, born from humble beginnings, has leveraged this frame work to critical acclaim. That game, as you may have guessed gentle reader, is *Bad News*.

7.3 *Bad News*

Dreams of the prospect of computational narrative suggest a future of deeply interactive and personalized fictional experiences that engage our empathy. But the gulf between our current moment and that future is vast. How do we begin to bridge that divide now, both for learning more specifics of these potentials and to create experiences today that can have some of their impact on audiences? I present to you *Bad News*, a combination of theatrical performance practices, computational support, and Wizard-of-Oz interaction techniques. These allow for rich, real-time interaction with a procedurally generated world. I believe that this approach could enable other research groups to explore similar territory—and the resulting experience is engaging and affecting in ways that help strengthen the case for our envisioned futures and also makes the case for trying to field such experiences today (e.g., in experimental theater or location-based entertainment contexts).

Bad News[2] is an award winning game enjoyed by players with varying degrees of performance experience. Players are placed in a procedurally generated town with over a century of simulated history, powered by the Talk of the Town framework described above in section 7.2. The bulk of gameplay consists of players engaging in actual conversation with NPCs performed by an improvisational actor. As the player moves about the town, the underlying simulation is updated via live-coding by a wizard, hidden out of the player's sight. Each play of *Bad News* begins with generating and simulating a new town from scratch; unique for that player and that player alone. Generating a fresh town for every playthrough ensures novelty for the player, actor, and wizard. It also enables a degree of internal consistency to the town's history—and produces it at a rate—that would be difficult for a human author to match. Players explore these towns with the goal of informing one specific resident of a recent death of a family member.

What results is an experience in which players interact with a deeply simulated virtual world that is capable of adapting to the actions of the player, a major goal for interactive drama [177, 141], albeit here with ample human processing power. The combination of a simulation, a live actor, and Wizard-of-Oz interaction techniques employed by *Bad News* is a useful one for developing and testing technologies that will enable future fictional experiences that are deeply interactive, generative, and personalized [146]. This is a design space that has only been preliminarily explored [57].

Moreover, works created by this research mode can be effective works of interactive

[2] Created by myself, James Ryan, and Adam Summerville.

storytelling themselves; *Bad News* began its life as a means to prototype integrating generative systems into a purely digital experience [238], but through the process of playtesting it was discovered that players found the experience of *Bad News* to be engaging in and of itself.

Bad News has been officially performed at several conferences and game festivals. Its maiden voyage was the 2015 EXAG workshop, after which the framing, premise, and set-dressing of the game underwent several important improvements. At the time of this writing[3], this revised version has since been performed at the 2016 ACM Conference on Human Factors in Computing Systems (CHI) (where it won the Innovative Game Design track in the Student Game Competition), as part of the Playable Experiences Track at the 2016 Artificial Intelligence in Interactive Digital Entertainment conference (AIIDE), and at a special Roguelike Celebration, with speakers and demonstrations from developers and enthusiasts of entries in the roguelike genre[4], San Francisco's 2016 Come Out and Play festival. Additionally, Bad News was selected as a finalist at the 2016 IndieCade festival of independent games[5], where it won the Audience Choice award. Although the game is an installation piece, and thus must adapt to the amenities provided by each venue, the structure of the game itself has changed very little since it was presented at CHI. Unless otherwise noted, descriptions herein refer to that updated version.

This section describes the project with a particular focus on the player experience and

[3]Early November, 2016
[4]Including none other than the creators of the original *Rogue* [300].
[5]Just like *Prom Week* before it!

the considerations of being an actor in this space. A more thorough description of the simulation can be found above in section 7.2; a more thorough description still can be found in the paper introducing it [239].

7.3.1 Work Related to Bad News

As an exploration of interactive drama utilizing live performance with directorial intervention, *Bad News* is connected to *The Bus Station*, an early Oz Project experiment that placed players among improvisational actors in a tense scenario managed by a hidden director [112]. This piece was intended in part to prototype a computational experience, and *Bad News* was born from similar motivations [238]. More recently, a gallery installation deployed *Façade* in an *augmented reality* environment, with human operators intervening to guide its reactive-planning ecosystem [57]. *Bad News* carries its torch in exploring the potential of mixing human and machine control in amateur live performance.

While *mixed reality* is a growing and fairly active area [189], there are surprisingly few media works that specifically combine computation and live improvisation. In fact, I am aware of only two other examples of this: *Coffee: A Misunderstanding*—a computationally assisted interactive play in which participants from the audience act out characters by performing dialogue and choreography selected by other human players [275]—and *Séance* [302], a piece in which three players and a guiding actor solve puzzles to commune with a spirit. Though *Bad News* is not performed in front of an audience, it still remains situated in the emerging area of computationally assisted experimental theatre [138, 249].

Broadly, the interplay of embodied conversation and deep simulation makes *Bad News* an example of a mixed-reality game [21], and its melding of computation and improv situates it alongside the work of Magerko [134], Perlin and Goldberg [202], and Hayes-Roth [98], though *Bad News* inverts the puppet-player relationship by having human-performed improv informed by the actions of virtual agents.

Beyond work in computational media, *Bad News*' approach has been influenced by Wizard-of-Oz techniques developed in human-computer interaction research [52, 60], and shares design goals with computation-less works of micro-performance [110].

Bad News' approach to relying on human processing power to bear all narrative responsibility might remind you, gentle reader, of my discussion of Jason Rohrer's *Sleep is Death* [227] way back in chapter 2.1.5. However, while *Sleep is Death* provides a canvas with characters, settings, and props to inspire storytelling, there is no internal simulation of the narrative world; all narrative responsibilities are solely the purview of the players. *Bad News* similarly leverages the human capacity for storytelling, but augments it with a deeply modeled world for the players to explore and interact with.

At the 2012 Dagstuhl gathering on Artificial and Computational Intelligence in Games, the Computational Narrative working group named "systems that generate tailored story-based support for face-to-face role playing used in corporate training and simulation" as a valuable short-term research direction [131]. I believe that *Bad News* is a major step along this trajectory. Though the worlds that it generates are player-agnostic, one could imagine *personalizing* towns for the needs of a player [146]. Similarly, It is nighttime, August 13, 1979. You are alone in a house at 702 Hustert Street in the town of Steel Creek, pop. 366. A deceased person lies before you. He is a light-skinned man with glasses, short black hair, and a soul patch. You must locate his next of kin and inform that person of this death.

Figure 7.1: The initial gameplay prompt is displayed on the player interface. The address, town name, town population, and deceased are results of the simulation, and are unique every game.

Bad News is not intended for corporate training (besides, perhaps, for a very specific profession, see Section 7.3.4.2), but the underlying technology could be used as such with a different diegetic framing.

7.3.2 The Game

As I've discussed, *Bad News* is a game about death, death notification, and everyday life, combining deep social simulation and live performance. Before diving into the game's three major components—the simulation in 7.3.3, the player in 7.3.4 and the actor in 7.3.5—let us provide an overview of the game itself.

7.3.2.1 The Premise

The player is cast in the role of a county mortician's assistant, brought to a small American town in 1979 to investigate and identify an unidentified dead body, hereafter referred to as 'the deceased.' The player's character has never been to this town before; the only person they know is their mentor, the county mortician himself. However, before the investigation can begin, the mortician reveals that a crisis the next town over requires his attention, and that the player will need to handle this job on her own. Namely, the player will need to identify the deceased, ascertain the name and location of the deceased's next of kin, and then deliver the eponymous bad news. Before leaving, the mortician assists the player in brainstorming a cover story for herself, one that will enable her to easily gather information from townsfolk without raising suspicions. The opening message presented to the player during one particular playthrough can be seen in figure 7.1.

The game ends as soon as the player divulges the death: victory if the notified is the next of kin or loss if not. This encourages the player to seriously investigate the town; revealing the death indiscriminately lessens the dramatic build up to the final reveal, which is intended to be a meaningful experience. In descending order of legal familial closeness, a character's next of kin in this town is their spouse, parent, child, sibling, and then any member of their extended family. Although this descending order might strike some as feeling artificial—many might claim that they would feel closer to their child than their parent, and those with an unfortunate upbringings might place parents at the bottom of their next-of-kin list—the ordering is important as it ensure that players need to do some sufficient sleuthing to determine who exactly, among potentially many family members, is the next of kin. The United States' official ordering of one's next of kin can be found here [316]; though *Bad News* gives one's parents a higher precedence over their children, so as to lessen the frequency with which players must notify a young child of their parents' passing.

Note that the framing of the mortician's assistant was one of the major additions from *Bad News*' original performances. The original premise simply had the player form their backstory with the aide of an extradiegetic guide (see chapter 7.3.4.1); this backstory was then taken as the ground-truth of the player's existence (as opposed to a constructed identity designed to make the ground-truth of the player being a mortician's assistant). Although many players adopted to this framing quite readily, some took real umbrage at the fictional inconsistencies such a premise invited (e.g., if the player's excuse for searching for the next-of-kin is to deliver them a check from the Publisher's Clearing House [198], then why on earth were they in the deceased's home in the first place[6])? All in all, the current framing of the piece still affords the player ample room for creative construction of their role, while conveniently filling in numerous plot holes the previous framing left unaddressed.

7.3.2.2 The Physical Setup

I'll now discuss the physical setup as it pertains to the live performance. The player and actor sit at opposite ends of a table, though a *model theatre* with closed curtains obstructs their view of each other. When the player interacts with an NPC portrayed by the actor, the actor draws the curtain to reveal himself; when the conversation concludes, the actor closes the curtain to reinforce that either the actor's or player's character left the scene. See figure 7.2 for a photo of the game's lovely model theatre,

[6]For a brief moment, the game designer's considered revealing at the game's conclusion that the player is actually the infamous "next of kin killer," systemically working their way through a chain of serial murders by dispatching the next of kin of their previous victim. Though an amusing—if grim—thought, it was quickly dismissed, as it severely undermined the game's design goals of presenting a somber and honest portrayal of death.

Figure 7.2: The model theatre that separates the player and actor during gameplay.

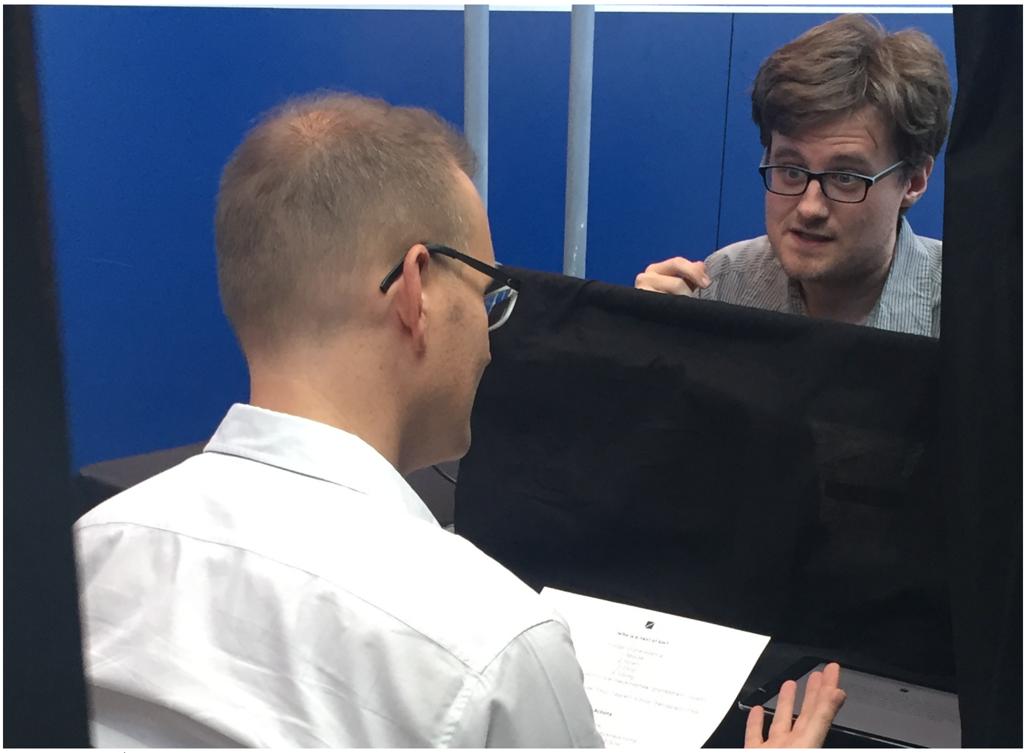

Figure 7.3: A player and the actor during gameplay. The player engages in embodied conversation with the actor, who improvisationally performs as a resident of the town.

and figure 7.3 for an action shot of a *Bad News* conversation.

The player is given a notebook and pen, as well as an electronic tablet that displays game state information, such as her current location and the physical descriptions of people nearby, as well as custom messages written by the wizard. The actor has a laptop that has an interface (see section 7.3.5.2) providing insight into the characters that he will be portraying. The design of the model theatre prevents the player from seeing the actor's laptop.

This physical arrangement has a few advantages over a stage. Both actor and player require easy access to their devices; having them rest on a table frees hands for gesticulation. The piece is meant to be personal; the lack of audience seating precludes spectators. It also enhances the accessibility and mobility of the piece: one might not always have a theatre at hand; one nearly always has a table. One limitation of this arrangement is that the player may only speak with one character at a time. Three party conversations are rare, only occurring when the actor engages in a one-way conversation with "offstage" characters.

Ideally, *Bad News* is played in a quiet, darkened room, in which the player's attention is focused solely on playing. The tone of any given run of *Bad News* can vary greatly, and the atmosphere in which it is played seems to greatly influence this variance; well-lit spaces tend to yield less emotional weight behind the actions of the player, antithetical to the design goals for the game.

7.3.3 The Simulation

Before gameplay begins, a town is generated using the *Talk of the Town* AI framework. As it has already been discussed in more detail in 7.2, the system will only be outlined here as it pertains to *Bad News.* The reader is also encouraged to consult existing publications on it for more information [238, 234].

Each *Bad News* setting is created by simulating the development of a fictional small American town from its founding in 1839 to 1979, which takes roughly five minutes. This amount of simulated history was selected because it produces towns with around fifty businesses and several hundred residents, which was found to provide a rich player experience without being overwhelming. The end date of 1979 was "modern" enough that player's did not feel obligated to adopt historical affectations, as they might if the town took place during a historical period such as "the wild west" of the latter half of the 19th century. Moreover, from a technological advancement standpoint, 1979 affords many conveniences most players are likely to be familiar with and can make use of (e.g., cars and telephones), but lacks others that could prove to be game breaking (e.g., the internet, cellphones).

Character appearances and personalities (using the famous five-factor model [46]) are modeled. At each time step, characters make decisions about where to go based on their personalities, their social and family networks, and their daily routines (which may take them to work, on errands, or to places of leisure). If multiple characters are in the same location, there is a chance that they will talk.

This communication between characters facilitates the passing of knowledge from one character to another. Characters converse about themselves and others in their lives by sharing specific details. These details might pertain to occupations, addresses, physical descriptions, or familial connections. From continued interaction, friendly or romantic feelings may asymmetrically form. However, as time advances in the simulation, characters' confidence in their knowledge begins to wane if it isn't continually reinforced; thus, for example, friends who have had a falling out will slowly begin to forget the details of the other's life. As this happens, characters may unknowingly spread false information.

Moreover, characters may lie to one another by intentionally spreading information that they believe to be incorrect. After nearly a century and a half of this simulation, characters build up a comprehensive—though occasionally factually inaccurate—view of the town that they live in and the people that populate it.

Additionally, characters get married, have kids, leave jobs or start new ones, found businesses, move out of town, and pass away; all of which contributes to a gradual construction and evolution of the town's physical layout. Utility-based selection [133] guides character decision-making. Birth, death, and marriage rates, as well as baby names and the types of businesses that are founded and folded, come from historical U.S. census data; actual historical events such as world wars and natural disasters are not modeled beyond their reflections in this data. A child's personality is informed by those of their parents. Each business type has a set of occupations to be filled (e.g., retail establishments have cashiers, managers, janitors, etc.), and hire for these positions based on the applicant's personality, age, work history, and familial and social connections; family businesses in the *Talk of the Town* framework are a frequent occurrence.

Though the town may be fictional, an important design goal of *Bad News* was to make it *a game about real life.* The player interacts with run-of-the-mill people living in a small American town. They have jobs, families, and friends. They run errands. They have leisure time at neighbors' houses, or they unwind at the bar. There is no explicit model of narrative in the simulation, but, as others have articulated [254, 146], narrative-like meaning can still emerge bottom-up through empathic social interaction with rich characters.

By simulating over a century of history, *Bad New* characters embed in rich social contexts that are brought to light through player interaction (see chapter 7.3.4) and actor performance (see chapter 7.3.5). This does mean that it is the responsibility of the actor and wizard to discover "interesting" elements of the simulation, and for the actor to gently steer conversations to points where these elements can be brought up naturally—this requires a combination of *story recognition* [237], *experience management* [222], and improvisation, skills that less experienced actors and wizards may need to develop. When done well, much of the joy of playing *Bad New*—for player, actor, and wizard alike—lies in discovering the inherent wonder in the seemingly mundane lives of these simulated characters.

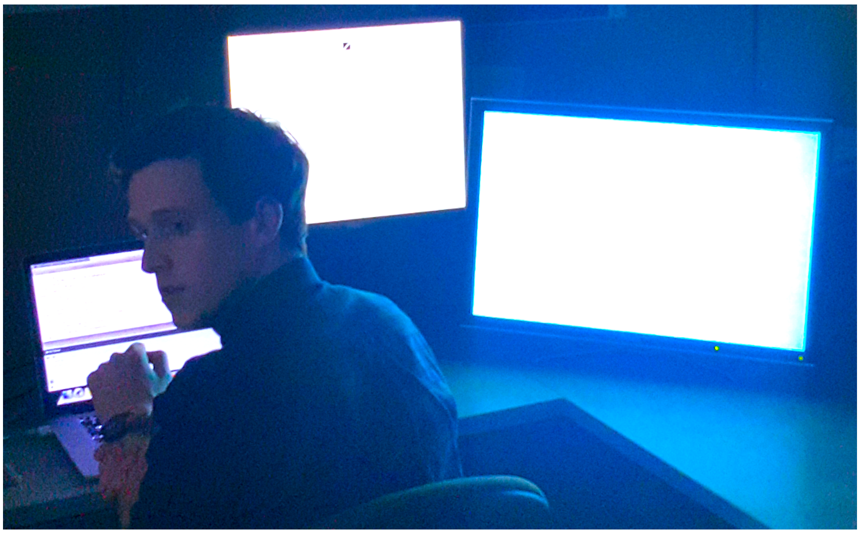

Figure 7.4: The wizard sits behind the scenes, live-coding modifications to the simulation and sending information to the actor.

7.3.3.1 The Wizard

Though the bulk of simulation occurs before play begins, there is one important figure of the town whose actions must be executed in the live simulation throughout gameplay: the player. To this end, the game employs a wizard sitting out of the sight of the player who listens to the vocal commands of the player and updates the simulation accordingly. Thus, every time the user travels to a new location, the wizard relocates the player's avatar from one part of town to another via live-coding. Similarly, other actions afforded to the player (see Section 7.3.4.1) are enabled by the wizard making live updates. Additionally, the wizard queries the simulation to search for narrative intrigue and potential dramatic nuggets that may be nestled in all its accumulated data. These nuggets can then be delivered to the actor over a direct line of communication (an instant-messaging service). This relationship is explored in more detail in section

7.3.5.3. Suffice it to say, keeping track of the player's commands, listening in on dialogue interactions, live-updating aspects of the simulation, all while hunting through the town's history to find narratively interesting snippets, requires a heroic amount of effort and focus. Figure 7.4 shows our stalwart wizard in his natural habitat, incredibly making all of the above look easy.

7.3.4 The Player

The ideal player of *Bad News* is open to improvisational roleplay. It has been well recognized that not everyone views themselves as, or wants to be, an improvisational actor [87]. However, the trappings of performance and narrative reside in the very fabric of our being [109, 162]. Roleplaying has the ability to be profoundly transformational [204], but accessing personal memories around the sensitive subject of death can place players in a vulnerable, uncomfortable state of being [276]. The goal in creating *Bad News* was to give players the capacity to tailor the emotional depths to their own comfort levels; the actor will read the cues established by the player—including their use of language and tone of voice, their body posture, and the backstory they fabricate for the character they choose to assume—and attempt to match that energy. See Section 7.3.4.2 for more on establishing this contract of care; see section 7.3.5 for more information on the actor's process.

You are viewing the Crooked Creek residential directory.

Abrahams
322 Colfax Avenue
Ackerly
453 Colfax Avenue
Aide
522 Colfax Avenue
Aide
361 Colfax Avenue
Aide
431 7th Street
Albin
357 3rd Street
Alquist
533 Belzer Avenue

Figure 7.5: The player views a residential directory.

7.3.4.1 The Priming Process: The Guide

Bad News begins with an extra-diegetic guide who leads the player to their seat. The guide eases the player into the world of the game, explains the premise and their role as a mortician's assistant, hands them a journal and pen to take notes, and describes what actions the player can take. These actions include beginning a conversation with an NPC in the same room as the player, looking at the city residential directory (which displays each residential address and the last name of the family that lives there, on the player's tablet. See figure 7.5), looking at the city business directory (which displays the address and name of every place of business, including restaurants, schools, hospitals, etc., see figure 7.6), traveling to a specific address or business name directly, or, in

Figure 7.6: Excerpt from a business directory for a procedurally generated town, as displayed on the player interface.

traditional Interactive Fiction fashion, moving in the cardinal directions relative to their current position. Players can also knock on doors, buzz apartments through an intercom system, and enter and exit buildings. Finally, players can advance the game's simple day–night cycle. Doing so causes the simulation to continue; all of the NPCs of the town will go about their lives: going to work, returning home, running errands, and sharing information.

These actions are taken by voicing them aloud (e.g., "I go to the quarry."), allowing the wizard to hear and then update the simulation—and thus the content on the player's tablet—accordingly.

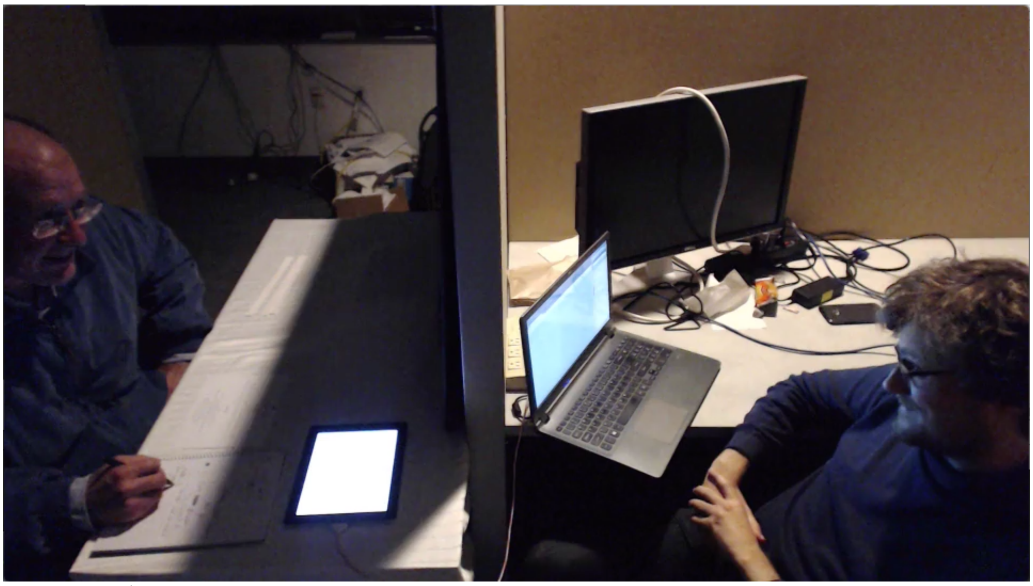

Figure 7.7: A "screenshot" of the first public performance of *Bad News*, prior to the introduction of the model theatre and mortician framing. Here the player, left, engages the live dashing actor in embodied conversation.

7.3.4.2 The Priming Process: The Mortician

Once the player sits down, the guide informs her that she'll soon be speaking with the mortician, and leaves. At this point, the player's tablet has a message instructing the player to announce out loud when she is ready to begin. Once she speaks this command, the tablet displays a physical description of the deceased. While the player reads and takes notes on the deceased, the actor opens the curtain as the mortician, greets the player as his assistant, quickly explains that he will have to leave soon, and directs the player to notify the deceased's next of kin on her own. Before he leaves, the mortician asks the player to only reveal the death to the next of kin, so as not to cause undue shock to the town and to respectfully allow the family to choose how to share the news of their loss. The player and mortician collaborate to weave a convincing cover story to justify the player approaching strangers and asking them questions. This is the approach *Bad News* takes to establish a contract of care, or simply contract, with the player. In an immersive theatre context [132], these contracts are design strategies that work to make the unfolding experience safe and delivered with care for the audience members. By diegetically framing the player as a mortician's assistant, but giving her the opportunity to develop an additional role on top of this, the designers found that players had enough narrative scaffolding to feel comfortable exploring the town, while still retaining enough creative freedom that their characters truly belonged to them.

As mentioned in chapter 7.3.2.1, originally all of the gameplay mechanics and goals were explained by the guide, and the player was given absolute free reign in creating their character, as opposed to the current creative control over their *cover story* while they are diegetically framed as the mortician's assistant. However, this led to some attempts at undesirable subversive play 7.4.1.4. Moreover, this tended to make the introduction a tenser experience than was desired: by having an extended conversation with the guide, with a lot of "warning" that they would be speaking with an improvisational actor, it built up a lot of anticipation towards the first encounter with an NPC that not all players found pleasurable. Moreover, because (prior to the introduction of the mortician's assistant) there was no guarantee what the personality of the first character the player happened to meet would be, it was possible for the first character the player encounters to be ill-tempered, unhelpful, unknowledgable, or just generally mean. Several players, before play, expressed to the guide that they wanted the characters to "be nice to them," which the actor used to inform his portrayal of the characters (while still being true to their simulation). However, by having the player interact with the mortician almost immediately, it significantly reduces the time for the anticipation of meeting an NPC to build up. The mortician is also the mentor of the player's character, so it is guaranteed that the first interaction the player has is going to be with a sympathetic party.

Additionally, the mortician is the only character in the game that is not modeled in the simulation. As such, the actor has a little bit of additional flexibility to adapt the personality of the mortician based on the behavior of the player. For a glimpse as to what the game looked like in its original, pre-mortician incarnation, see figure 7.7.

7.3.4.3 The Moment of Truth

Once the player has discerned the identity and location of the next of kin, she must let that character know of the deceased's passing. The hope is that by exploring the town and meeting its residents, players will have a mental picture of the deceased's life, and will develop empathy for those the deceased left behind. Consequently, the game aims for the reveal of this passing to be the emotional peak of the experience; though there has been a range in how players treat this significant moment, all have been respectful and civil. One observed behavior is the inclination to make the next of kin as comfortable as possible before the reveal. This can be as simple as asking the next of kin to take a seat; sometimes it involves asking them to go somewhere private. Some players have had noticeable hitches in their voices as they deliver the news, stumbling over the words as they struggle with how to break the news of the death of a loved one.

Although the above indicates that the game does a good job of putting players in the desired frame of mind, some players will have a conversation with the next of kin but not be entirely sure if they have indeed found *the* next of kin or merely a relative. In these situations, players have refrained from informing the relative of the death, and left the conversation to continue gathering information to verify that they had indeed found the right person. Although this is an example of a ludic goal (winning the game by finding the right person) clashing with a gradual rise in emotion—as that initial conversation with the next of kin has at times ended abruptly—it also enables the player to get to know the next of kin a little better; they are not delivering the news to a complete stranger, but rather someone that they have now had multiple interactions with, which brings its own sense of sentimentality to the final reveal.

7.3.5 The Actor

As previously mentioned, all of the non-player characters in the town are played by a single actor. All performances of *Bad News* to date have used the same actor: me![7] The person who wrote the dissertation you are reading, gentle reader. As mentioned in chapter 1, I have a professional performance background, including more than ten years of improvisation experience. However, to spare you from my vanity (and to make the the description as broadly applicable as possible) I shall continue to refer to the actor in the third person, as it is my sincere hope that someday folks are able to play *Bad News* without me being physically present. Maybe *you* can be the next *Bad News* actor!

[7]Incidentally, I was also the actor in *Séance*, briefly referenced in 7.3.1. Does this make me the world's expert in improvisational acting under computational constraints? Probably not! Is watching me perform in myriad roles a core appeal of the *Bad News* experience? Maybe, but a humbler person would never even broach the thought.

As discussed in Section 7.3.2.2, the actor remains out of sight until the player engages an NPC. Also hidden is a laptop that displays an actor interface (see Section 7.3.5.2). Since the actor does not know the qualities of the characters he will be playing until moments before assuming that character, the actor must learn to parse the interface quickly.

7.3.5.1 An Actor Prepares

Though the characteristics of the characters performed are determined by the simulation, the performance of the actor in *Bad News* is improvised. Thus, improvisational theory for quickly determining and ascertaining character relationships is incredibly useful for the actor to know and employ, such as status dynamics [109], or recognizing the "heat and weight" of a relationship [106]. It is also important for the actor to familiarize themselves with the Big Five personality traits (extroversion, agreeableness, neuroticism, conscientiousness, and openness to experience) [46]. These serve as a convenient brush to broadly paint the shape of a character and provide a useful hook for an "outside-in" approach to informing a character [166]. Although real values $[-1, 1]$, these are split into five partitions for ease of access for the actor. Other key characteristics, e.g., age, gender, occupation, and beliefs, also contribute heavily to the actor's physical and vocal choices.

Though the actor remains seated the entire time, characters still express themselves through physicality. A low-extroversion or high-neuroticism character might hunch over in their chair, cross their arms, or otherwise posture themselves as small and guarded as possible. Highly agreeable characters might stick out their chest or lean in toward the player to demonstrate that they are a friend. A low-neuroticism, low-agreeableness character might comfortably lean back in the chair, conveying disinterest in the player and their search.

Similarly, strong vocal choices convey character. Volume is an easy vocal quality to modulate based on personality—for example, low-extroversion characters tend to be more soft-spoken. Openness to experience can impact the nature of words used; characters with low openness employ a simpler vocabulary. The location of the conversation impacts the character's demeanor as well. A highly conscientious character at work is likely to be professional and guide the conversation, assuming the player is a patron needing to be assisted, even if the character happens to have unsocial traits such as low extroversion or low agreeableness; elsewhere that same character might act differently.

Though these personality traits assist the actor in quickly assuming a character, the actor must still fill in the details that lead to a memorable, believable, distinct character during performance. These details are determined through character-specific decisions made during conversation, through observed attitudes toward others characters in the town, and through insights provided via chat with the wizard[8]. These details make the

[8]These insights often take the form of the wizard finding interesting elements of the simulation that could make for good narrative material. For example, in one memorable playthrough, a restaurant that had been in the town for over a century—almost unheard of in the simulation, as every year there is a chance the restaurant will close—had recently closed down. This restaurant had been a family business, passed on from father to son for generations, until the childless second-to-last owner bequeathed the establishment to his nephew, who had been a waiter there. A few months later, the restaurant folds. All of this was generated by the simulation; the wizard was able to discover it, pass it along to the actor, and suggested that this is something that is general knowledge among the townsfolk. Armed with the knowledge, the actor could then make informed decisions about how the characters themselves felt about this situation (e.g., angry at the nephew, sympathetic for him, apathetic about the whole thing, etc.)

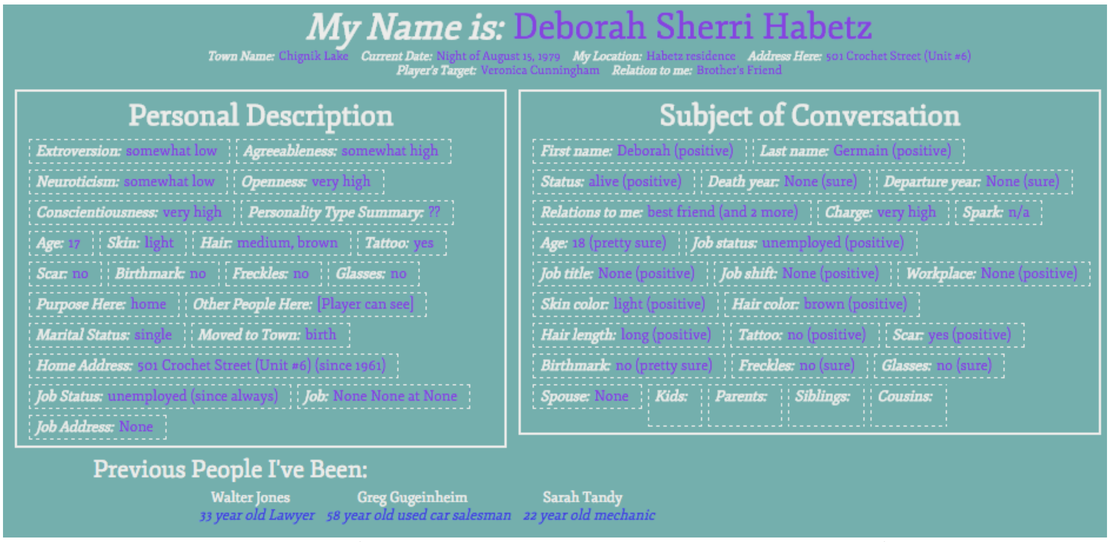

Figure 7.8: The actor interface. The Personal Description on the left contains details pertaining to the character the actor is currently portraying. The Subject of Conversation is what that character believes about another character currently being discussed with the player (which updates in real time as the conversation shifts). The "matches" section is not shown.

character feel more alive; the actor is allowed to invent these details as they see fit, so long as they build upon facts established by the simulation and do not contradict it in any way. For instance, during one playthrough, the player encountered a painter at a construction company eating lunch at a diner. During this conversation, the character revealed his aspirations for moving to New York and striking up a career as an independent artist, dreams not present in the simulation. After this character revealed their goal, the player then gave the character advice on how to achieve their dream. This serves as a nice example of how the broad outline of a character can inform fine-grained details, which in turn can lead to tender moments.

7.3.5.2 The Actor Interface

Displayed via a hidden laptop—and in figure 7.8—the interface is divided into three parts: information about the character the actor is currently playing, information pertaining to another character that is the topic of conversation, and “match” information (see below). The currently played role fills in once the player initiates conversation. It has information regrading the character’s personality, profession, age, gender, marital status, physical appearance, and their reason for being at the current location (work, errands, leisure, etc.).

The second section, regarding the subject of conversation, is populated with data whenever the conversation veers toward a specific character. It consists of everything the character currently being performed knows about this other character, as well as how they feel about them. Since characters can get facts wrong about each other (see Section 7.3.3), next to every belief is a confidence rating. Characters can have accurate information but not be confident about it, and conversely can be supremely confident in information that is wrong. There can also be gaps; e.g., a character might have no idea where another character works. The actor can choose how upfront they are about their uncertainty.

The final section contains a list of “matches;” after the player asks a broad question (e.g., “do you know anyone who is blond with a scar?”), it is populated with every person the character knows that matches the description. This section of the actor interface is also maintained as part of the wizard’s responsibilities.

7.3.5.3 Peeking Behind the Curtain

When not updating the simulation, the wizard has time to explore the history of the town and the interweaving relationships of its denizens. When he unearths narratively interesting tidbits, he communicates them to the actor via a chat window. This relates to the *story recognition* challenge of emergent narrative [237]. Sometimes even small things, such as a date, can deeply inform character behavior. For example, if the wizard sees that the character has a child whose birthday is coming up, it can inform both the demeanor of the character (happy, harried, etc.), and provide justifications to their simulated behaviors.

Often the information is more complex, involving love triangles and other rich emergent phenomena (enumerated in [234]). In one playthrough the player was visiting the store where the deceased worked. The wizard was able to discover that the deceased had very high mutual attraction for the store's manager. Moreover, this manager was a man who was significantly older than the deceased and already married, but his spouse was harboring romantic feelings for a coworker of her own. This manifested when the player spoke to a mutual acquaintance of the manager and the deceased: a gossipy teenager who insinuated that the manager, unhappy in his home life, had been flirting with the deceased. This scandalous behavior provided a bit of drama in these characters' lives, but also cued the player that she might discover information by speaking to the manager.

Just as the actor can "invent" justifications and motivations as long as they build off of information established by the simulation, the wizard may do so as well, and communicate that to the actor. Thus, though the actor has the unique responsibility of determining how information about the world is revealed to the player via performance, the information itself is unearthed and developed by the actor and the wizard working in tandem as both story recognizers [237] and experience managers [222].

7.3.6 Sample Playthrough Summary

To give the reader a sense of the general progression of a game of *Bad News*, I present a summary of a thirty-minute playthrough. The player was a male in his mid-20s with two years of improvisation experience. To elucidate creative sources, we'll append parenthetical attributions specifying the sources (player, actor, or simulation) of details and actions. Though these attributions detail the diegetic decisions and actions of the actor, player, and simulation, the wizard is secretly communicating with the actor (through an interface and chat) about the simulation and updating the player's tablet with information about their physical location, nearby residents, and directory information, thus influencing the behavior of both player and actor. I remind the reader that every run involves a uniquely generated world; the characters, relationships, and histories in this playthrough were never seen before, nor will they ever be seen again.

After speaking with the mortician in the game's introduction, the player left the deceased's apartment and checked the residential directory to quickly ascertain the last name of the deceased (*player, simulation*). From there, he found a janitor in the apartment complex, and asked the janitor if he knew the deceased by name or anyone matching the deceased's description (*player*). The janitor confessed that he did not know any of the tenants (*simulation*), but suggested that the player go to a nearby delicatessen, which was a popular hot spot in town (*simulation, actor*).

The player went and found it to be crowded (*simulation*). Observing the characters in the deli, he sought out someone with similar features to the deceased (*player, simulation*). Doing so, he managed to find the deceased's aunt—the sister of the deceased's father—who in fact had inherited the same physical features of the deceased by virtue of their common ancestry (*simulation*). The aunt was open-minded enough to not mind sharing her table with a stranger (*simulation, actor*), and after the two exchanged introductions and the player learned the aunt's surname (which was the same as the deceased's; *simulation*), he knew he was on the right track. He explained he was a historian chronicling the history of the town (*player*), hoping she would tell him more about her family, and ultimately the next of kin. The aunt obliged, telling familial history that reinforced the game's theme of loss: her father had been a town blacksmith for forty years of life, but as the march of progress advanced and demand for blacksmiths all but disappeared, her father lost his smithy and—after decades of being a skilled artisan—had to find work as a stocker at a grocery store, until he passed away (*simulation, actor*).[9] The player sympathized with the aunt, and asked if there were other members of her family he could speak to (*player*).

Feeling connected with the player after sharing her family history (*actor*), the aunt

[9] This was an artifact of the underlying simulation's modeling of industrial progress, which makes smithies likely to shut down in the period after World War II. The daughter's emotional opinion on these affairs was a choice of the actor.

told the player that her brother is a janitor at a nearby department store, whose shift was ending soon (*simulation, actor*). The player thanked the aunt for her time, and rushed to the department store (*player*). The player entered the store after hours (*player, simulation*), and a manager irately approached him (*actor*). Before being ushered out, the player spotted the janitor (on the tablet's listing of nearby characters; *player*), who was best friends with the manager (*simulation*). The player struck up a conversation with him (*player*), which the manager begrudgingly allowed (*actor*). It became clear that the janitor was the deceased's father (*actor*), and therefore his next of kin (*simulation*). Out of respect for the father's privacy, the player did not want to reveal the death with the boss glaring at him (*player*). The player offered to meet the father at a bar when he was done with his shift (*player*), which he agreed to (*actor*).

At the bar, the player quickly got into an altercation with the bartender (*player*), who viewed the player as childish (*actor*). The player managed to calm the bartender down without a fight breaking out by asking him to mix a drink (*player*, *actor*), just as the father arrived (*actor*). The player then asked him to take a seat, somberly revealed his true profession as a mortician's assistant, and respectfully informed the father of his son's passing (*player*).

In this playthrough, there was a chain of what could be considered fortunate circumstances; the janitor happened to direct the player to the delicatessen where the deceased's aunt was; the player managed to join the aunt, and from her learn the whereabouts of the next of kin, and from there was able to locate him and inform him of the death. However, many of these fortunate circumstances either came from the player's own perception (such as thinking to seek out someone that looked like the next of kin) and details of the simulation (traits, like appearance, are passed to offspring). The dramatic moments of the story (the aunt discussing the sad history of her father, the player bursting into the department store after hours, or the father not wanting to inconvenience his friend and boss), were either driven by the player, or were simply the actor adopting an emotional opinion about truths about the world; nothing was specifically fabricated or manipulated for this world.

7.3.7 Preliminary Results and Critical Reception

These results are derived from brief 5-10 minute postmortems (immediately after playing) with the approximately thirty players who had played the game through playtesting, at EXAG 2015, and at CHI 2016, as well as through my own observations (and those of my colleagues) of players during play[10]. The postmortems involved describing the underlying system to the players (e.g., the simulation process, the actor's interface, etc.), and asking players how they felt about the town they explored (e.g., whether it felt "hand-crafted" or generic, whether the characters were believable) and the decisions they made (e.g., did the player feel like they were the driving force of the narrative). Additionally, when time permitted, the wizard would advance the simulation thirty years in the future, generating an epilogue of sorts, providing players the opportunity to learn what happened to the people they met as they entered the new millennium.

[10] Between AIIDE 2016, Come Out and Play, the Roguelike Celebration, and IndieCade, the total player count of *Bad News* is now closer to 60. Nothing that was seen in these latter playthroughs contradicts anything that I've written, and in fact, even supplements it. One player called it one of the most profound game experience's he's ever had!

The most striking observation is how quickly players eased themselves into the role-playing aspect of the experience. Many players expressed discomfort, most often about lacking training in improvisation, before playing (and sometimes during play itself at the start). However, as play progressed, players stopped verbalizing these discomforts, and began showing investment in the role by thinking aloud about the town and who to talk to next.

Was was mentioned in above in 7.3.2.2, the environment plays a substantial part in how somberly players approach the experience. In general, the brighter and more open the space, the less players have invested themselves in their roles. Beyond the physical space the game is performed in itself, I have also noticed the presence of an audience having a consistent, curious effect on players. Either players get particularly self-conscious, or they put on an affected performance. By affected performance, I refer to players not committing themselves to the world of the game and instead opting to make jokes and perform actions for the benefit of their audience. This observation is interesting, as the authors would like future incarnations of *Bad News* to be spectated, but not if it comes at the expense of the quality of the experience for the player[11].

[11] One potential middle ground, that has only been attempted once (at the Roguelike Celebration) but seemed to have mostly positively results, is to set the game up as a form of a radio play. In this setup, the actor and the player are sequestered away in a private room, while the wizard operates from a separate room filled with an audience. Though the actor and the wizard communicate with each other as before, additionally all of the audio from the "play room" is piped into the room with the audience. In addition to the audio, the wizard can project their screen for the audience to see; giving them insights into the actor's interface, the python console through which the wizard affects the simulation, the live chat between the wizard and the actor, and the text that is currently displayed on the player's tablet. Although the wizard is typically very focused performing wizardly duties during gameplay, the guide can provide explanations to the audience, pointing out relevant information on the screens based on the audio (e.g., "Ah! The actor likely said that because they are playing a character with X personality and they believe Y about the person they are talking about"). And, as was mentioned above, watching the wizard live-code is a performance in-and-of-itself. This allows for the player to have the privacy I value so highly, while potentially many spectators can still experience much of the content of the

Perhaps the most assuring piece of feedback from the postmortems was that many players expressed that the experience felt very unique—both by virtue of the fact that this is a gameplay experience unlike most others, but also because the player has free reign to explore a town with hundreds of characters in any way that they choose. Thus players report feeling high senses of agency over the shape of their gameplay session. Players have said that they felt *transported* to the world [91], and were able to readily visualize the people that they spoke with and the places that they visited. Many players found their towns so vibrant that they were shocked to learn during the postmortem that the towns were not designed by hand. This suggests a promising use of this framework—and the technology that powers it—in future applications of games and stories to enable high senses of player ownership over their narratives.

In addition to positive player interviews, *Bad News* has received positive critical attention as well, winning the Innovative Game Design track of the 2016 CHI conference Student Game Competition, determined by a jury consisting of experts in game interfaces and assistive role playing technologies. It was also one of thirty-three games nominated for awards at the 2016 IndieCade festival of Independent Games, selected over nearly a thousand entries[12]. And, as I couldn't help but already mention above

piece. However, though the audience was not present, we still told the player of this experimental play through that an audience would be present listening in. Although it might perhaps be a coincidence, this player still engaged in behavior that implied an awareness of being spectated, making several extra-diegetic utterances mid-game that expressed an understanding that people were listening to her, and was the only player to date who began speaking directly to the wizard, who would then respond by directly providing response's on the player's tablet. Although this type of behavior led to several comical moments—moments cited by the audience as being highlights of the performance—it once again proved to be a demonstration of spectators disrupting the player's experience, even when the spectators were not physically co-located with the player.

[12]As was *Scéance*! Maybe I *am* a primary joy after all!

towards the beginning of chapter 7.3, it won the Audience Choice award, a humbling honor[13].

In summary, *Bad New*'s unique combination of live performance and simulation appears to have the potential to be a powerful new form of storytelling. The ability to generate towns with hundreds of NPCs with interconnected histories and relationships in a matter of minutes is fertile ground for rich emergent narrative. The open-ended framing of the game enables players to carve their own path, determining which locations and characters in the town become narratively significant—this meets the call for future directions in interactive storytelling articulated in [131, 237, 146, 254]. The casting of the player as a specific character that must develop a cover story simultaneously provides the player with firm scaffolding to build on with the flexibility to diegetically shift their identity—possibly multiple times in a single play session—lessening some of the vulnerability inherent in roleplaying. All of this facilitates somber, respectful engagement with mature themes in a first-person context. I, and the other developers of *Bad News*, sincerely hope that *Bad News* is the first of many pieces of its kind.

[13]And, truth be told, somewhat of a bewildering one, if for no other reason than due to its lengthy run time, approximately fifteen people were able to play it throughout the three day festival. Thus, though I choose to believe that the act of playing the game must have been something special for our players, immense recognition must go to my colleagues James Ryan—our wizard who worked his magic in a place view-able by the public, live-coding so furiously it is a performance in itself—and Adam Summerville—our guide who deftly and tirelessly explained the game to passerby. Clearly winning the award was a team effort, but I think we owe much of our IndieCade win to James and Adam. Thanks, guys!

7.3.8 Future Applications Inspired by *Bad News*

There are many exciting directions that *Bad News* could be taken in. One direction is to continue to refine the experience as it is now, perhaps by adding additional elements to the physical simulation. A more robust physical simulation might enable players to learn names by rifling through mailboxes, or to discover places that the deceased recently visited by searching their house for receipts or paystubs. Many players assume such affordances are already implemented, as many works of interactive fiction let players engage in verbs such as examining and picking up objects.

The designers have also considered expanding the system to include multiple actors and multiple players. Such a project would require a larger, dedicated space to be performed, but could be the basis of a larger scale mystery, in which multiple players must work together to assemble and share clues to reach a solution.

Though *Bad News* takes place in 1979, one could imagine the tenor of the game feeling very different if the experience took place at different points in history, or at multiple points in history. Many popular pieces of fiction involve the device of time travel and visiting locations and people at multiple points in history. One could imagine a variant of *Bad News* inspired by a classic 80s film, in which players begin play in a generated town in 1985, and then are tasked to explore that same town as it was simulated in 1955, meeting younger versions of previously met "contemporary" counter-parts, and affecting the simulation and generation process in the past for their ultimate return to their home time.[14]

[14] Great Scott!

Perhaps the most exciting future for this work is one that facilitates its ability to be distributed and played. One potential way to achieve this is to create a home version of the game, that could be set up and played in living rooms and dining room tables. Achieving this would likely require written guides and enhanced interfaces to train non-experts to fulfill the roles of actor and wizard. The major challenge to this endeavor is that *Bad News* depends on three trained individuals–the guide, the actor, and the wizard–that would be difficult to include in a home version of the game. Guidelines for the guide and the actor could be included in written instructions. Though there is no substitute for the years of training the current actor possesses, he (I) could perhaps attempt to transfer some of his expertise through writing to bootstrap others to assume the role of *Bad News* actor. Though the wizard could similarly write a wizardry guide, in addition to requiring an in-depth understanding of the inner workings of the simulation, the role of the wizard currently requires live-coding in python to access that simulation data. Thus, a successful version of the home game would likely require a wizard interface, to enable novice wizards to quickly peruse the simulation.

Of course, the dream might be to create a fully digital version of *Bad News*, and indeed, part of the impetus for creating *Bad News* in the first place was a method for generating utterances that could inform the creation of just such a piece. As savvy readers may recognize, this is an endeavor akin to the fabled holodeck itself; as such the work is presently ongoing, to put it generously.

7.4 *Bad News* and Shared Authorship

Let us now examine *Bad News* through the lens of shared authorship.

7.4.1 The Strengths of *Bad News*

Like *Prom Week*—and unlike many of the other games discussed throughout this document—there is no preexisting story that the game is trying to tell, beyond the very broad "a mortician's assistant informs a small town resident of the death of a loved one." That story is, of course, the player's goal, and again like *Prom Week*, the game leverages that goal as a scaffolding to help guide the player and direct their play. Unlike *Prom Week*, the game does not have a sense of time limiting the player to achieve its goal. Moreover, goals in *Prom Week* are hard; either they are achieved or they are not. Though the game attempts to weave a satisfying narrative conclusion regardless of the combination of goals reached—and the content of the player's path through the game is deeply affected by their history of actions—there is still a strict notion of success associated with each *Prom Week* goal. *Bad News* shares that with the game's ultimate goal (inform the next of kin) which the player can, in theory, fail in a variety of ways (perhaps by speaking to a family member that was not the next of kin, or someone not a family member entirely). However, it is impossible for them to work themselves into a fail state or otherwise render anything impossible until the very last moment of the game. All other "progress" in the game is less easily measurable than a strict goal. The player accumulates information, such as the identity of the deceased, but those are implicit goals that emerge through the design of the game (e.g., since the player is trying to notify their next of kin, it would be helpful for them to know the identity of the deceased), rather than enforced via the game's procedures (as opposed to, say, a quest flag that did not permit the next section of the game to be explored until the identity was uncovered).

Just as there is no pre-existing story, the fact that there is not even a pre-existing town prior to the player's arrival further helps contribute to the above. Although generating a town from scratch each time runs its own risks—as of this writing, there are outcries in the media of the danger of procedurally generated content being overly bland [135, 44]—this does not appear to be a trap *Bad News* is falling into. As mentioned in 7.3.7, many participants have expressed shock when they realized that the entire town was generated just for them; many assume that the town itself is static but a small part of the experience was random, say, the person killed. To me, this indicates the player perception of hand authored quality.

CiF and Ensemble are firmly rooted in the social systems that are authored for them. Though, as discussed in chapter 4.3, steps have been taken to make the authoring process as versatile and simple as possible, it nevertheless still requires a substantial amount of authoring effort to make a playable experience with characters that exhibit multifaceted social intelligence. *Talk of the Town*, meanwhile, has an advantage in that characters are simply transferring facts to one another. Thus, as was described briefly in chapter 7.3.8, one could readily imagine this same framework being applied in other domains, as it would primarily require creating new types of facets. For example, right now the game primarily reasons about people, businesses, and buildings. One could add in another category: birds. Entities of the bird category could have attributes such as name, species, dietary habits, and migratory patterns. And as simply as that, characters in a *Talk of the Town* game now suddenly have the capacity to be birders, sharing avian information as effortlessly as they gossip about each other. Of course, additional work would need to be done to the simulation to make it a true birding game.[15]

Another important factor is in both the player's and the actor's ability to perform their actions. That is to say, they choose not only the *what* of their actions, but the *how*; how they choose to move around the city, how to converse with its residents, and ultimately how to break the bad news. This was also seen in chapter 6.1.3 in a description of *Prom Week* instantiations: a single *Prom Week* instantiation can also be performed in many ways (though different initiator-responder pairs, different mix-in selections, etc.), as well as be interpreted differently based on the surrounding context in which it appears. Other examples of digital games that embrace the "how" include *Façade*—though it might ultimately only be parsing the "what" (i.e., what the player is saying, what part of the room they are standing in, what the viewport is directed at, etc.), but the player is still given the "how" to express themselves through the text parser and the ability to freely move and look around the apartment. Similarly, games with relatively static narratives but dynamic real time combat, such as *Mass Effect* or *Skyrim*, allow players to artfully dispatch enemies in fashions adhering to personal play-styles.

[15] For now, Nothing Sacred Games' *Birds of a Feather* [76] is still ruling that particular roost.

Bad News facilitates (and, indeed, requires) the player to determine *how* to enact change at both the global and local levels. That is, players determine not only the overall path they must take, but also how they perform every step of the way. This manifests itself in a multitude of ways; the length of the interactions the player has with townsfolk, the content of the conversations, the emotional tone they take, how the player chooses to react to what they hear, and so forth. Crucially for the cause of shared authorship, they are not making these decisions in a vacuum or in their imagination, but in conjunction with the actor and—less visibly—the wizard and the simulation, two thirds of whom are actively working towards validating their actions and incorporating their performance towards the construction of a cohesive whole; the simulation, though not actively responding to the player in and of itself, is updated through the wizard based on the player's actions. This, I believe, distinguishes *Bad News* from other pieces of "live performance" (such as Dungeons and Dragons), which might have a figure (say, the DM) do their best to maintain narrative coherence, but without a robust model of all of the denizens of their world, is more susceptible to inconsistency.

Another quality of *Bad News* that I feel separates it from most other performance-based brethren is that, for potentially long stretches of the game, the player is completely alone. When not engaged in conversation with the actor, the player sits by themselves at a table with a tablet, a notebook, and their thoughts. I have already emphasized how there are no spectators, but this also means that there are long periods of time where there is no DM, or other authorial force attempting to coerce the player to make certain actions during "downtime." Rather, it is a time for players to strategize and collect themselves, and determine what they want to do next. This I feel is bringing in some of the philosophies of Reed's sculptural fiction as discussed in chapter 2.1.1 pertaining to giving the player the means to reflect on the story created thus far, and affording them the ability to determine how to subsequently shape it, and in my experience is uncommon in live-performance based games, where making decisions quickly so as not to hold up the group is often valued more highly than taking the time to determine a more ideal course of action[16].

Though I would never claim to fully understand what is transpiring within the mind of any of the game's players, as the actor of *Bad News*, I am afforded a unique view of the players. I am particularly interested in the emotions and thoughts they express through their eyes, and the pride they show when they perform something particularly clever. The structure of *Bad News* provides many opportunities for players' creativity to shine, but has minimal punishments for resorting to straightforward play[17]. Players respond positively to even small moments of validating player creativity. For example, one player mentioned to the mortician that he read about a local event in the town's

[16] In this sense, the individual nature of *Bad News* is collaboration without compromise: the player is clearly still collaborating with the actor and system, but do not need to feel forced to compromise their narrative decisions for the sake of an audience or fellow players.

[17] In fact, the only real punishment I am aware of is if a player has a hard time getting started finding the first non-mortician NPC to speak to. Some players have wandered around the town, seemingly aimlessly, knocking on doors of empty houses searching for someone to speak with. Though this happens infrequently enough that the designers have not felt moved to change the game yet, a quick potential remedy would be for the mortician to inform players of potential "hot spots" in town where they could find a lot of people, such as bars or diners, before he leaves. This is not presently done for the same fear expressed in 6.2, namely that doing so would direct players opening moves too much, and ultimately reduce the variability in how players approach the game. As it currently stands, there are hundreds of residents in each generated town, and player's actions determine which of them "become the stars" as it were. Although it might be strategically sound to try to find and discuss with members of the family (and, indeed, this is often what players do), there is nothing stopping the player from "going off the rails" and exploring the town. In that sense it is like an open world game, and that is a sensation that the designers would be loathe to compromise.

newspaper that put the town in an uproar, but the mortician shook his head and said he didn't know anything about it. However, when the player conversed with NPCs of the town, several of them—without prompting from the player—brought up the event that the player had invented in the game's opening segment, expressing how it had affected them. The player's eyes just lit up. This was, perhaps, due to the delight of the paradox of the same actor (myself) at once denying and affirming his offer as two separate characters, though given how he then engaged in deep conversation with these characters about this event, it felt like his joy was at least in part informed by his recognition that his contribution had became an integrated part of the storyworld.

I have observed in previous chapters the potential for interesting shared authorship spaces that arise from unreliable collaborators. Unreliability is present in a few facets of *Bad News*. The first is perhaps the more obvious: because the characters lie, confabulate, and forget information during the simulation process, there is high potential for characters to misdirect the player as their knowledge may be rife with falsehoods. Additionally, the actor occasionally makes mistakes,[18] and says the wrong thing. That is, occasionally I will let slip information that my character—according to the simulation—should not be aware of. This can happen for a variety of reasons; most commonly it is because in an attempt to minimize the amount of time it takes to get into character, only the most pertinent details of the simulation are internalized before conversation begins. However, once conversation begins, it is a challenge to simultaneously speak and peruse the actor's interface. This does, perhaps, indicate a need for an alternative method of

[18]Though I try my best not to!

referencing the simulation, as violating the simulation is the closest thing *Bad News* has to cheating. However, because the only view the player has into the simulation is through the surface level performance of the actor, the player is often none the wiser. This is a bit of a philosophical quandary—if a tree violates the simulation alone in the forest does it count as cheating—but one which speaks towards the ultimate fallibility (and thus humanity) of the player's collaborator.

Again, leveraging my unique position as being intimately present for every playthrough of the game, after playing the game dozens of times, I feel that I've never quite been the same NPC twice, meaning that each player's pool of collaborators are, at least in the simulation level if not on the performance level, unique to them. Additionally, many players develop completely original backstories, further cementing the individuality of their particular playthrough. That said, there are some cover stories that arise with some frequency—either through the collective zeitgeist understanding of what it means for something to be a cover story, or simply because the mortician has only a handful of suggestions to provide players that do not wish to develop of story of their own. Some of these backstories—and common strategies for play—are outlined below in chapter 7.4.1.4. Even similar cover stories are distinguished by the distinct viewpoints players imbue them with.

I mentioned that many players feel transported to the world of *Bad News*. Perhaps my personal favorite manifestation of that transportation is the level of investment and commitment most players show to the denizens of the town, treating them like actual human beings. In many games, NPCs are simply fonts of information, quests, and rewards; the player approaches them to get what they need and—once dispensed—quickly flees. Although it is reasonable that this is how players would behave towards NPCs who only have the affordance to dole out what the player seeks, this is clearly not how people behave towards one another in real life. Though one or two players occasionally treated me "like an NPC," almost all players interacted with me as if I was a human being, and engaged in prolonged conversation with me; greeted me, introduced themselves, etc. It is difficult to say whether it is anything inherent to the design of *Bad News* itself which fostered this behavior, or if it was simply the fact that they were, indeed, interacting with a living breathing human just a few feet away from them, but the fact that players were still engaging in such social behavior regardless was heartening. Perhaps *Talk of the Town* could be applied to pieces specifically designed for social and cultural training, such as the IMMERSE and EMIC projects [257, 130], see also chapter 3.1.

I think it is interesting to look at *Bad News* through a lens of immersion, and the dance it plays between being an immersive experience and being a distancing one. Akin to the Brechtian theatre (see chapter 2.2.1), *Bad News* makes no pains to disguise or obfuscate the room in which it takes place, partly since its installation based nature means it must adapt to the circumstances of the venue it is performed in. The player is placed before—and speaks with someone behind—what is clearly a model theatre. The theatre itself, though beloved by the designers and crafted with care, has spraypaint that is beginning to fade, exposing its skeleton of PVC pipe. The alienation effect is further present in the disconnect between the technology used (namely the player's tablet) and the diegetic framing of the piece (the late 70s). Thankfully this anachronism has not appeared to cause players to assume that such technology exists within the world of the piece. When not conversing with the actor, I often hear players think or talk out loud, sometimes about their thoughts on the experience as a whole, further indicating that they are not losing themselves in the piece, but rather are acutely aware of who they are, where they are, and what they are doing. However, when they talk to the actor, they (appear, at least) to be deeply engaged, fully invested and immersed in the conversation. The only time when this was notably not the case was an experimental performance in which a team of players played concurrently, and extra-diegetically spoke with each other throughout the experience. Much as how Brecht's theatre afforded evenings of simultaneous entertainment and critical reflection on one's self and one's society, I believe *Bad News*'s use and disuse of immersion allows players to think critically about the shape of the piece, thus giving them the ability to better steer it and author it in directions they please. I also think the immersive ebb and flow helps prevent *Bad News* from feeling like a flat experience, as described above.

One of the game's greatest virtues is also one of its biggest shortcomings, as will be described in 7.4.2: the fact that the game relies so heavily on a human interface between player and simulation in the form of the actor. The positive impact having a human in the role is immense. The drama and experience management the human role provides alone is notable: from the contract of care established during the mortician segment, to gently suggesting places and people for the player to visit, to being emotionally affected by the player's delivery of the death notification, the human takes on a lot of responsibility. Likewise, the narrative of *Bad News* is entirely emergent, but unlike emergent narrative in many other games, the choices and actions that transpire are remembered and built upon. It is uncommon for games to be able to do this; *Prom Week* was able to through its use of the social facts database and the game's design centering around the creation of and reaction to such social facts. *Bad News* is able to do this because the experience is largely driven by humans, capable of honoring and remembering the emergence.

7.4.1.1 *Bad News* as a Facilitator for Role Playing

Although this was already discussed in some detail in 7.3.7, I would like to revisit what I think is an important component to the game for player comfort: the different layers of identity the player adopts while playing. Namely, there are three levels of identity at play:

Player's actual self.

Player's actual character (the mortician's assistant).

Player's cover story.

The player's actual self is who they really are—sans role playing or characterization—informed by the myriad decisions they've made and circumstances they've encountered through the course of their life. In *The Form* terms this would refer to a 1st degree reality (see chapter 2.2.3). Once gameplay begins, they are immediately assigned a character to role-play, the mortician's assistant, who represents who they "really are" in the context of the game, and thus the character that they need to commit to. For those without a background in theatre or improvisation, committing to a character can be a frightening prospect, performing a character can potentially be a decidedly unpleasurable act, as I discussed way back in chapter 1.3. *Bad News* assists players in overcoming that fear by paradoxically encouraging further characterization in the form of a cover story, the game's third layer of identity. If the framing of *Bad News* was different—if it, perhaps, leaned more towards the player giving a faithful, convincing performance—then this structure likely would induce more anxiety than it would relieve: to adopt a singular characterization (e.g., asking one's self "how would this character behave") is difficult enough without adding an additional layer (e.g., "how would this character behave as this other character?"). However, since *Bad News* demands very little in terms of serious characterization, the above is thankfully not a concern. Instead, the dual roles the player assumes—I believe—contribute towards freeing them from failure, as the character that they are playing (the mortician's assistant) is in fact going through the precise same experience that the player themselves are going through, namely role-playing. Thus, if the player "slips up" in their role in some way[19] it can be readily, diegetically attributed to their *character*, not the player. Freedom from fear is an imperative part of a successful performance, and an important part of feeling like a valuable, creative contributor. *Bad News*' clever framing helps make this freedom possible; something that I believe all works of shared authorship should strive for.

[19] I am a firm believer that it is impossible to "slip up" in a circumstance such as this. Everything said contributes to the tapestry which is the playthrough; nothing detracts.

7.4.1.2 Actor as Interface to Collaborating with the Simulation

Although I have been primarily describing the authorship of *Bad News* as being shared between the player and the actor, clearly the player is engaging with the simulation as well. The simulation is robust and expansive enough for the player to be able to explore it through their navigation of the world, but it is also malleable. Though the player lacks ultimate authorial control to change reality on a whim (as an author of a traditional written novel might delete a sentence, and in so doing completely transform a character), they can still make meaningful impact on these characters' lives. One notable example of this involved a player conversing with an NPC who took his job as a joke. The NPC was employed by his son, and believed that it was only given to him out of pity. This caused him to feel uncommitted to his work, and generally darkened his life and clouded his relationship with his child. The player could easily have left this character alone—almost the entirety of their conversation was completely tangential to the player's pursuit of the next of kin—but chose to engage in a prolonged discourse with them anyway, about the nature of work and family. By the end of the conversation, the NPC actually felt genuinely better about his lot in life, and was eager to reconnect with his son. Though the player made these changes through interaction with the actor, the changes can still be reflected on the simulation level.

7.4.1.3 *Bad News*, Agency, and Ownership

I think that *Bad News* actually does a pretty good job of painting a difference between agency and ownership, two terms I think sometimes get conflated. Let us take a moment to appreciate each phenomenon in the context of *Bad News*. In brief, I believe that *Bad News* affords high levels of ownership—the play through of each player is uniquely their own, brought about by their own actions—but varying degrees of agency, depending on what aspect of the game is being examined.

Namely, the amount of agency players possess is high in the context of conversations, but relatively low when exploring the town. Having multiple systems with imbalanced levels of agency is certainly not unique to *Bad News*; this is akin to a traditional RPG that provides high agency in combat, and low agency in conversations or advancing the game's narrative. To spell it out, the levels of agency are low outside of dialogue in *Bad News* because there are far more formal affordances that players can conceive than are actually implemented. One cannot rifle through mail for an address, check pockets for a driver's license, or search for family photos to get an early glimpse of the next of kin; all actions that players have—understandably—attempted in a variety of playthroughs[20].

But even though the levels of agency in the game vary from phase to phase, the level's of player ownership are consistently quite high. This is due to a number of reasons: every choice that the player makes is clearly their own as they are not simply selecting options from a menu. The world is relatively vast, and players need to be good detectives to determine where to go and who to speak with. Although characters (informed by actor and wizard) might encourage the player to speak with certain people

[20]It should be noted, however, that the wizard—in addition to his myriad other duties—can send small messages to the player's tablet. There have been one or two instances of a player attempting an action not strictly permitted in the game, such as searching for any clues as to what the deceased's next of kin looks like, and the wizard quickly sent a message to the effect of "you see a small portrait of a woman with brown hair." That portrait was not modeled in the simulation. That is to say, it was not actually present in the world. But the wizard was able to create a convincing enough illusion of it that the player was satisfied and felt comfortable moving on with the game.

to get more clues about reaching the "goal" of the game, the player has the power to determine how they choose to follow up on those clues, if they even decide to follow through with them at all. Thus, though there are some very notable things that the player cannot do (speaking to moments of low agency), everything the player does do is through their own determination (speaking to consistency high ownership).

To help illustrate some of the self determination of *Bad News* players, I think that this is a good time to segue into a brief discussion on common strategies employed by players, and *Bad News*' opportunities for subversive play.

7.4.1.4 Common Strategies and Subversive Play

Although every playthrough of *Bad News* is guaranteed uniqueness due to the uniquely generated town per play, the biggest differences from run to run occur based on the players and their playstyles. Although they share the common goal of identifying the deceased, and identifying and locating the next of kin, there is much variety in how this plays out. Some begin by exploring the deceased's neighborhood, figuring that the deceased's neighbors will likely know them. Others choose to visit heavily populated establishments, such as bars or restaurants, hoping that they might run into someone who knows someone that matches the description of the deceased. Still others recognize that there are some key municipal buildings, such as the town school or hospital, and reason that they may be able to gather information from the deceased's doctor or teacher.

A major distinguishing factor is the nature of the cover story. Players have concocted a wide range of cover stories, including confessing to developing a crush on someone who matches the description of the deceased and asking characters where they might find him, or saying that they have a child who was spending time with the deceased, but they haven't heard from their child and are growing worried; these stories are just impersonal and indirect enough that most NPCs didn't question the player for more specifics, while still being personal enough that most NPCs were moved to help. Other strategies have played on the vanity of the townsfolk, including players claiming to be historians and reporters that are gathering information for their work. Still others have tried to gather information by being intentionally disturbing. The most memorable case of this was a player who alluded to—though never explicitly stating—that they were a member of a secret society; most NPCs were so off put by this they told the player what they wanted to know just so that they would go away.

One player used the residential directory in a capacity unanticipated by the game designers; the opening of the game tells the player their current address: the location of the deceased. The player in question, before doing anything else, cross-referenced this address against the residential directory, and used that to determine the last name of the deceased. He continued to look in the residential directory for other homes inhabited by families with the same last name; within the first minute, he had narrowed down the possibilities for the next of kin without any conversation. Even though he had managed to find family members using only the residential directory, he still had to engage in conversation with them to determine who the actual next of kin was. Though this tactic was unexpected, since families in *Bad News* can potentially be very large, with many generations of cousins living in the town, it might yield a large list of family members. Moreover, the next of kin might have a different last name than the deceased (e.g., either the deceased or next of kin took the name of a spouse). Though this strategy can be powerful, careful investigative work through conversation is still needed to succeed at the game.

Prior to developing the framing of the mortician's assistant—in which players were given no guidelines about their actual character and told only to develop a cover story—one player attempted to poke holes in the system by assigning game-breaking (and simulation contradicting) characteristics to their actual character, including stating that she was the long lost spouse of the deceased, and thus she was the next of kin and had therefore won the game, as she had clearly been made aware of the deceased's passing. This same player tried painting themselves as a time traveler from the distant future, and thus they had access to powerful technology that would enable them to breeze through the game. Although casting the player as the mortician's assistant seems to have addressed some of these concerns, I do not want to fall into the trap cautioned against in [290], where the creators of the simulation are so intent on their vision that they coerce potential collaborators to relinquish their own creativity. Though these examples of subversive play are perhaps over the top—both result in an experience of trivial length—in general me and the other Bad News designers want to foster and encourage an environment in which players feel free and encouraged to leverage creative approaches to the game. *Bad News*' improvisational nature lends itself well to this aim, and its current incarnation appears to foster engagement that is both in line with the designers wishes, yet still frequently surprising and unexpected.

7.4.2 *Bad News*' Weaknesses

The most damning criticism of *Bad News* in a dissertation about creating computational works that enable shared authorship is that it relies significantly on humans to achieve its goals. The presence of humans affords wonderful advantages, many described above, but sadly without humans at play there are no computational mechanisms to fall back on. For example, I have discussed how all of the narrative in the system is emergent. The actor and the wizard are capable of leveraging their natural human proclivity for recognizing narrative to unearth the narratively interesting sequences of events from the town's entire simulated history. That is to say, though these interesting sequences were created by the simulation, the simulation itself has no recognition of their significance.

For example, in the sample playthrough referenced in chapter 7.3.6, it was the simulation that determined that the dad lost his smithy job, but it was the actor that perceived that he went from a position of skilled-labor to one of unskilled-labor, who understood that that is a transition that often causes grief, and who made the decision that both the father and daughter viewed the job change as a tragedy and were emotionally affected by it. Moreover, the actor recognized that in the context of the playthrough as a whole, the NPC telling a tragic personal story was thematically appropriate to *Bad News*' overall theme of loss, and that the context of telling this story was unusual but acceptable. That is, though it is uncommon for strangers to share such personal stories with one another, the NPC had already allowed the player to sit at the table—also an unusually gregarious act—establishing themselves as someone willing to break social norms.

The above describes an exchange that lasted only a few minutes of a single playthrough, and yet it depended on a tremendous amount of human level processing that would be difficult to operationalize. Incorporating some element of “non-emergent” narrative into the system that could be presented to the player might lessen the flexibility of the stories created—significantly problematic for works of shared authorship—but also might lessen the system’s dependence on human storytellers. Though creating an experience in which a computer alone is capable of providing a shared authorship experience is the dream, there is still much value to be had in developing technologies that enable humans to collaborate each other and tell new kinds of stories as well.

Besides the (notable) issue above, there is also some cause for concern regarding the system’s generality. Though the *Talk of the Town* framework is very general, the design of *Bad News* lends itself towards stories about interpersonal relationships and businesses in a small town. Generally the most emotionally charged exchanges that have transpired have centered around these themes: a young artist dreaming of moving to the big city, a widow who hadn’t left her house since husband’s passing, and many more. Although the game has a degree of intrigue, since the player is framed as being undercover, it would be difficult for a playthrough of *Bad News* to be about, say, a tale of spies and espionage. To do so would require much invention on the part of the actor that would violate the underlying simulation. That is, the simulation has no notion of the profession of “spy” but it does have an understanding of teachers and quarry-men.

For the actor to take a character labeled as a quarry-man, and claim that they are in fact an undercover operative, is a falsehood not modeled by the simulation. All the same, violation though it may be, it is important to note that the game does in fact allow for this, even if it doesn't facilitate it; in the cultist playthrough described in 7.4.1.4, when the player found the next of kin, he was surprised when the actor decided to establish the next of kin as actually being a member of the cult, a violation of the simulation, but a validation of the player's claims up to that point.

7.5 Conclusion

And thus concludes my examination of *Talk of the Town* and *Bad News*. I confess, *Bad News* does occupy a special place in my heart, as it borrows much inspiration from the improv community I hold so dear. Though the game does rely on humans to help discover and carry the narrative, the simulation ensures novel, rich, complex social worlds that can be generated with a consistency and celerity difficult for a human author to match. These worlds form the perfect playground for participants to jointly collaborate on pieces of shared authorship.

I'll summarize my above discussions by presenting a ranking of *Bad News* across the eleven design dimensions of chapter 3.2, and revisiting the diagram of chapter 3.3 (or, more precisely, chapter 5.5) to see where *Bad News* appears on the map.

	Human Collaborator	Performing Collaborator	Immersion	Simulation	Playtraces	Visible Collaborator	Reliable Collaborator	Game States	Space and Convergence	Visible Story Values	Cohesive Final Product
Bad News	4	4	1	4	4	4	2	4	3	2	1

Table 7.1: Ranking *Bad News* across the dimensions of chapter 3.2.

As is likely no surprise, *Bad News* scores very highly on many of these dimensions. Through its framework of combining an actor, a wizard, and a simulation, *Bad News* manages to simultaneously score very highly in both areas pertaining to computation (e.g., its high scores in simulation, play traces, and game states), and also in the perceived humanity of their collaborator, as well as the collaborator's ability to perform and have a hand in shaping the narrative themselves. For reasons such as these, I believe that *Bad News* is a very strong example of a piece of shared authorship. However, as has been made abundantly clear, *Bad News* achieves much of its properties through ample use of human processing power. One could, perhaps, make the claim that the collaborator of *Bad News* is *too* human, as it will take a substantial amount of further development and research before the currently human enacted roles of the wizard and actor could be successfully replaced by purely computational mechanisms.

That said, *Bad News* stands as stalwart affirmation that this envisioned future is one worth working towards. And, I feel it is worth mentioning, that *Bad News* has left a strong impact on many of its players. Thus, as a cultural contribution in and of itself,

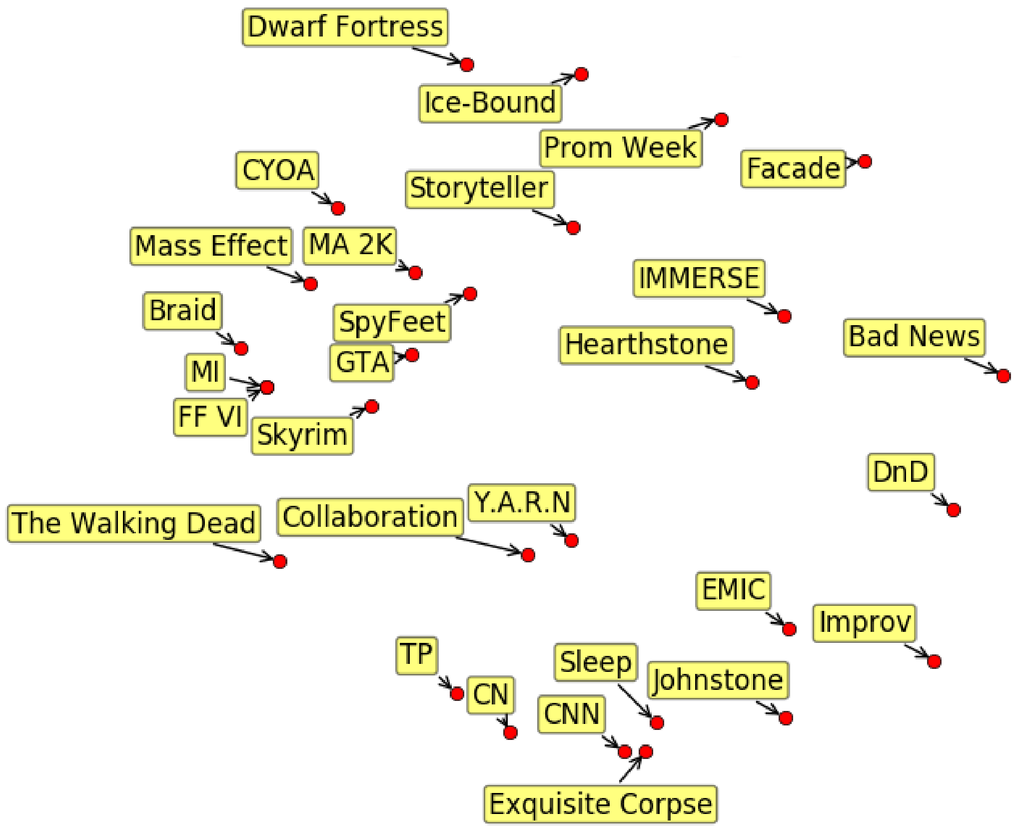

Figure 7.9: Our visualized design space first introduced in chapter 3.3, now with *Bad News* included. *Bad News* is along the far right edge of the space; a middle ground between the heavy simulation of pieces such as *Façade* and *Prom Week*, and the human-to-human experiences such as *Dungeons and Dragons* and improvisational performance.

Bad News remains worthy of praise.

In revisiting the visualized design space in figure 7.9, we once again find this piece in the upper right hand quadrant. More specifically, *Bad News* finds itself along the far right edge. This appears to make sense; Bad News is a unique combination of deep simulation, world generation, and improvisational performance. It therefore stands to reason that it would find itself situated between the heavy simulation-based games that dominate the upper right quadrant, and the performance-based human-to-human collaborations in the lower right quadrant. It is heartening that the chart appears to agree with my personal estimation that *Bad News* is pushing on the boundaries of novel shared authorship design space.

I shall discuss one final system before calling it a day. Though a work in progress, I have taken all that I have learned from my previous experiments, and have attempted to integrate them into one piece. A piece that is pure collaboration between a player and a system, focused on jointly creating stories. A system that attempts to facilitate play and put the player at ease. A system that has a rudimentary understanding of story, can recognize the contributions made by the user, and make proposals of its own. A system that can recognize narrative inconsistencies, and attempt to brainstorm resolutions for them.

In short: a system that attempts to be a good *Writing Buddy*.

Chapter 8

Ongoing Work and Conclusions

8.1 Introduction

As we have seen many times throughout the course of this dissertation, computational media has proven itself to be a powerful medium for telling stories. The playable experiences I have discussed in depth thus far—*Prom Week* and *Bad News*—are responses to the many interactive stories available today that achieve their interactivity through devices such as branching narratives. As I have discussed, players engaging in such experiences are often presented choice points, which will alter the course of the narrative; this can be an effective means of allowing the player to tailor a story to their desires, but it is an act of guidance, selection, and uncovering an existing narrative, rather than creation. Even *Prom Week* can be reduced to such a description, although the amount of potential story paths it is capable of providing is tremendously larger than the typical choice-based narrative game.

Back in Chapter 1.2, my discussion of shared authorship began with the acknowledgment that the act of making a story can be very pleasurable; there is inherent joy in creation, and penning a story can be an excellent way to express one's self. However, it can also be a daunting process; overcoming the oppressiveness of a blank page is merely the first of many challenges a would-be author must face. Writing partners can help one overcome these challenges, but might be difficult to find. This chapter introduces *Writing Buddy*, an in-development prototype of a playful tool that is meant to serve as a digital writing partner. By working and playing with *Writing Buddy*, players create—rather than discover—simple, narratively consistent stories.

Prior to introducing a new playable experience, I have been presenting a description of the underlying technology which enables it; this chapter is no exception. What marks this chapter as slightly different, gentle reader, is that you are in fact already well acquainted with the two primary underlying technologies which power *Writing Buddy*: The Ensemble Engine (discussed in chapter 4.3) and Playspecs (discussed in chapter 6.3.2). In my discussion of *Writing Buddy*, we'll address how these two systems are being applied towards this new prototype of shared authorship.

8.2 Work Related to *Writing Buddy*

Although I have thoroughly discussed a stable of inspiring efforts to the cause of shared authorship in 2.1, there are certain existing research agendas that are key motivators for *Writing Buddy*. There are many examples of computer systems capable of generating stories [116, 122, 165, 201, 301]. Though some of those systems allowed for interactivity, they were largely passive experiences for the player, i.e., the player was being told a story rather than creating one themselves. Many of these generators are either author-centric or character-centric; the IPOCL planner [223] recognizes the importance of characters acting believably within a coherent plot. More recently, the NetworkING system [206, 207] generates plan-based stories after users fine-tune character social relationships; the Wide Ruled system [265] enables players to chart similar plans themselves.

Other recent experiments, such as *Creative Help* [226] which builds off of the *Say Anything* [289] system, aids the user in producing full stories with creative control throughout the process. *Creative Help* takes free text written by a user, compares it against a substantial corpus of English-language stories, finds a similar sentence in the corpus, and presents the next sentence from the corpus story as a suggestion for the next sentence in the user's story; both were discussed back in chapter 2.1.2. This work allows for deep creative freedom on the part of the player, but the system has no semantic understanding of the story being written. This lack of an internal understanding has been recognized as a problem in mixed-initiative computational storytelling [119], and one which has at least been partially addressed in other domains, such as procedural architectures [128], level design [271], and quest generation [288].

In addition to being a tool to help players create stories, interacting with *Writing Buddy* is meant to be playful. As such, it shares design philosophies with casual creators [43], and is an example of AI-based game design [63], in which novel AI technologies enable new forms of gameplay (see chapter 2.1.2.5 for a description of both). This notion is related to the ideation-implementation-simulation cycle of co-creating with story generators outlined in [290]. Other examples of such experiences include *Endless Web* [270], *Storyteller* [13], *Prom Week* [154], and *The Ice-Bound Concordance* [217]. *Storyteller* and *Ice-Bound* are particularly relevant as both involve players constructing stories. *Storyteller* asks players to construct stories that satisfy short narrative puzzles, emphasizing puzzle solving over player self-expression. *Ice-Bound*, on the other hand, gives players more freedom of expression, while learning about a pre-existing backstory. *Writing Buddy* attempts to meld the features of these examples by giving the player creative control to shape the length, content, and characters of the narrative, while still providing specific narrative goals.

8.3 *Writing Buddy* System Description

The intended audience of *Writing Buddy* are casual authors interested in tinkering with dramatic beats and character actions. Though players are free to play with different characters and actions in a social physics-guided sandbox (see 8.3.2), *Writing Buddy* provides narrative goals for those seeking a more directed experience. Since myriad stories would satisfy these goals, "solving" them is meant to evoke the puzzle-solving pleasure found in games, while assisting players in creating stories they feel creative ownership over. As the player begins crafting their stories, *Writing Buddy* provides suggestions for narratively consistent character actions, shows hypothetical possible worlds the player might wish to pursue [241], and helps recognize overarching themes and character arcs. As the player solves more goals, they are presented with increasingly challenging writing prompts meant to provide the player opportunities for creative self expression.

In order for *Writing Buddy* to be a collaborative writing partner, it must be able to reason over character desires and actions, as well as have an understanding of overarching storylines or plots. To achieve this, it uses libraries that, though well suited for this purpose, have prior to this work never been used in just this capacity. Namely, it uses the *Ensemble Engine* [248] to calculate and determine character behavior (see 8.3.2, or chapter 4.3), and it uses the play trace analyzer *Playspecs* [192] to recognize and reason about larger-scale, plot-level moves and moments (see 8.3.3 or chapter 6.3.2). Before I discuss the precise uses of these technologies in this system, I will first give a broad overview of how one engages with *Writing Buddy* to create a story. This section will conclude with a brief example of how one might construct a story using the system (see 8.3.4).

I remind the reader that *Writing Buddy* is still under development. The elements described in 8.3.1 and 8.3.2 have been implemented; 8.3.3 is in development.

8.3.1 The Authoring Process

Writing Buddy has three authoring modes: beat, action, and prose authoring.

8.3.1.1 Beat Authoring

Beat authoring is intended to capture the broad strokes of the moves of the narrative. The term *beat* is inspired by Robert McKee's usage of the term [163] (which also informed the seminal interactive narrative *Façade* [280]), though in truth it is closer to his description of a *life value*. A beat, otherwise known as an emotional exchange, is meant to be the smallest unit of dramatic content that can occur between two characters. A life value, then, is a character's state of being that changes over scenes through a progression of beats. These values often deal with large themes (e.g., life, hope, elation) and their opposites (e.g., death, despair, sorrow). *Writing Buddy* collapses this structure; whereas McKee would argue for a life value to change after multiple beats, *Writing Buddy* associates a life value change (i.e., a character state change) with every beat. Similarly, the state changes currently present in *Writing Buddy* tend to be less grandiose, to make it more believable that such swings are possible given the shortened time.

Due to this one-to-one relationship, beats take the form of a specific state and its opposite. For example, one beat might call for a character that is angry at another character to lose this anger. Another might call for a physically weak character to find the strength to overcome this aspect of their nature. The specific beats present in the system are represented by the Ensemble Engine (see 8.3.2). *Writing Buddy* goals request the creation of a story that contains specific beats. The user can add, remove, and reorder beats to the story with no constraints through a simple graphical user

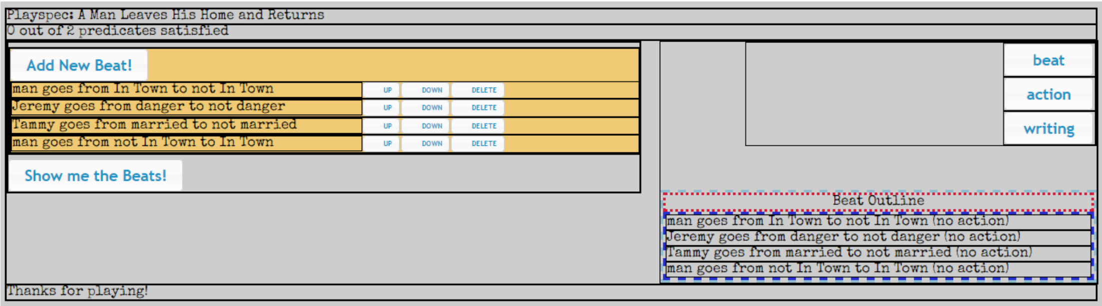

Figure 8.1: A preliminary sketch of the prototype. This current story has four beats, all awaiting action assignation.

interface (see figure 8.1 for a preliminary sketch). At this level, *Writing Buddy* does not enforce any form of narrative cause and effect or overarching plot structure; the player is free to add or remove beats to tell a story in terms of changing life values that suits their interests. Beat authoring does not in and of itself change the underlying state of any of the characters of the story, or their relationships towards one another; that occurs when the player assigns actions to beats.

8.3.1.2 Action Authoring

Action authoring has players assigning an *action* to each beat. Whereas a beat is an abstract concept of intended state change with no actual impact on the modeled status of the characters or the narrative, actions have actual effects on characters and their relationships to one another. For an action to be assigned to a beat, three criteria must be true. Firstly, the action must have an effect which satisfies the beat being described; for example, if the beat is detailing a character transitioning from being angry at another character to making peace with them, then the action must have the effect of removing that anger. The second criteria is that characters must have the volition to perform the action; to continue my peace-making, just because actions such as *shake hands, tell joke,* or *apologize* might have the impact of making characters form peace with each other, if the characters involved do not have the volition to engage in those activities, they will not be presented as options for consideration. They will, however, be presented as *almost actions* (AAs, see below). For more detail on the volition formation process, see 8.3.2 (or chapter 4.3). Thirdly, actions have preconditions which must be satisfied. To continue my example, a beat calling for two parties to stop being angry at each other only makes sense if the two parties are indeed presently angry; if they are not, then actions which depend on their anger to be true will not be applicable. The system, recognizing that there may have been an authoring error at the beat level, will also include the actions whose preconditions were not satisfied in the list of almost actions.

AAs refer to actions whose effects would satisfy the beat in question, but that are not applicable for any of the aforementioned reasons (the characters do not have the volition to engage in this action, or the preconditions for the action do not hold). Players are presented with the list of AAs for each beat, along with a description of why the action was disqualified from actually being assigned to the beat. Presenting this list is meant to have a twofold effect for the player. One is strictly informative, and explain why certain actions the player might have thought were applicable are not in this context. The other is to provide insight into the underlying state of the system, and spark creativity towards adding story beats that could make the action viable. It is a form of emergent narrative through hypothetical consideration; by seeing the possible worlds which could be true under different circumstances, the player might take inspiration in attempting to make those circumstances come to pass [246]. Once the player has added enough beats to satisfy the goal set out by *Writing Buddy*, and each of those beats has been assigned an action, the player can move on to the final authoring process.

8.3.1.3 Prose Authoring

Prose authoring allows the player to write plain-text prose to accompany each beat. Beyond the underlying state changes encoded in the actions themselves, this stage of authoring represents the performance realization of the actions. The system has no means of reasoning over this text, and thus the player may free write whatever they wish. I fully acknowledge that the final prose of a piece are incredibly important to the discourse of its narrative, and at present *Writing Buddy* places the responsibility of its creation entirely on its users.

8.3.2 Ensemble

Beats, character volitions, and actions are represented using the Ensemble Engine. Although I'm confident you still remember my discussion of Ensemble (and its progenitor, CiF) from chapters 4.3 and 4.2 respectively, (or, perhaps, you may enjoy reading their original publications here [248] and here [160]), I will regale you with its workings once more in the context of *Writing Buddy*. In *Writing Buddy*, Ensemble is responsible for keeping track of characters, their current state, and the actions that they may take towards one another. In addition to maintaining the current state, Ensemble keeps a history of every discrete state the characters of the story have been in. Each of these discrete states is called a *timestep*. Each beat is considered to be a separate timestep.

To determine the actions available for assignation to a beat, Ensemble calculates the volitions of the story's characters. This is done through the evaluation of Ensemble "influence rules." Each rule consists of a precondition and corresponding effects that affect character behavior. For example, characters that are rivals will be more likely to try to one-up each other. Actions, then, are tied to these effects; arm-wrestling, spit-contesting, and drink-quaffing might all be considered actions that characters trying to one-up each other might engage in.

Because each beat represents a separate timestep, and because actions can be assigned to beats in any order, *Writing Buddy* marks the first experience using a social physics engine in which players may edit the past. This is an important feature, as sometimes in the authoring process writers may wish to start in the middle or end of the story and fill in the beginning afterwards[1]. In the spirit of AI-based game design [63], this requirement from the game inspired improvements to the AI, as prior to this point, Ensemble only allowed operation in the present, adding each new action to the end of history. Enabling the functionality to add actions prior to "future" ones has involved validating that changes made to a beat in the past do not obviate the actions already assigned to beats which come after it. For example, if a later beat is currently assigned an action with the precondition of two characters being enemies with each other, that action will no longer make sense if the player resolves the conflict between the two characters prior to that action taking place. When a previously assigned action becomes

[1]This feature will be included in the planned release version of Ensemble.

problematic for reasons such as this, the system highlights the issues for the player to resolve.

8.3.3 Playspecs

Playspecs, as you undoubtedly recall from chapter 6.3.2, were designed as a means of analyzing a game via play trace analysis, allowing for regular expression operations to be applied to both player inputs and game states, originally described in [192]. In short, an individual Playspec details a sequence of player inputs or game state that the game designer is interested in, and a play trace is one such sequence generated via gameplay. A trace is said to match the Playspec if the trace contains the specific sequence outlined in the Playspec.

Up to now, Playspecs have been used in post-game analysis; after collecting play traces, one uses Playspecs to discover if certain game states are ever encountered, any outliers indicating subversive play, or otherwise extraordinary behavior. *Writing Buddy* plans to integrate Playspecs into the gameplay itself. The integration will take place on multiple levels. First is a simple level of recognition; any given goal is defined as a Playspec. As beats are added and removed, the current list of beats will be run through the Playspec; if the list of beats matches the Playspec then the goal of the level will be met. Besides recognition, Playspecs could also be used to propose new beats to add, to capture the feel of an active writing partner. Casual users may opt to disable this feature, preferring themselves to be the primary arbiter of narrative content. The capability for players to author Playspecs to share with one another is a long-term goal.

8.3.4 Simple Example Interaction

To clarify the authoring process, I present a simple scenario illustrating use of the system. When the player starts using *Writing Buddy* they are presented with a goal; the goal for this example is to write a story in which a man leaves home and returns. The player begins by authoring beats. They see that they can author a beat in which a man goes from the state of "being at home" to "not being at home" and adds that to the list of beats. Similarly, they then add another beat that changes the state of the man from "not being at home" to "being at home." The story now has these two beats, and the Playspec representing the goal lets the player know that the beats they have selected satisfy it.

The player then attempts to assign actions to the beats. However, they are stymied, as there are currently no valid actions for the beats as they stand. There are, however, almost actions that appear. One such almost action is labeled "storm out" but the player is informed that the man does not have the volition to perform this action, but would if he had gotten into a fight recently. The player then goes back to the interface for authoring beats, creates a new one called "man goes from not angry to angry", and adds it to the beginning of the list of beats. This causes the Playspec goal to re-evaluate the list of beats; the man still leaves home and comes back, so it evaluates as a success. The player then attempts to assign an action to their new beat, and finds that there is an action that the man is willing to do: "have an argument." The player assigns this action to the beat, which updates the underlying state of Ensemble. Now when the player attempts to assign an action to the "leave home" beat, Ensemble recalculates the man's volitions and determines that, yes, because the man had recently gotten into a fight, it makes sense for him to "storm out." The player assigns this action to the beat in question. A similar editing process can be followed for the beat pertaining to returning home.

Once all beats have been assigned actions (or before then, if the player so chooses), the player can begin writing prose for each beat. When doing so, they are reminded of the life value they are attempting to change associated with the beat (e.g., have the man go from not angry to angry), and the specific action that they selected to realize it (e.g., "have an argument"). Here they have the means to write whatever they wish.

8.4 Closing Thoughts on The Future of *Writing Buddy*

And thus ends my description of *Writing Buddy*, a mixed-initiative based playful tool to assist in story writing. By combining the character based social simulation system *Ensemble* with a real-time application of the playtrace analyzer *Playspecs*, I am in the process of creating an experience that combines the puzzle-solving pleasure found in games with an authoring environment that guides and assists players in creating narratively consistent stories.

Though this is a promising start, the system is currently just a prototype, and there remains much exciting work to be done. The system's current structure lends itself best to short, fast stories, since a story is nothing more than a collection of beats, and each beat changes a life value. Future incarnations of this work could incorporate additional structure, introducing the notion that it takes many beats to constitute a single scene, many scenes to compose an act, and multiple acts to tell a story.

Embedding *Writing Buddy* into a fully realized game seems a natural extension of its playful design. One can imagine such an experience framing the player as a struggling writer: the player's reputation would be determined by the nature of stories they pen; their prestige would grow as they solve more challenging authorial goals, earning new characters, beats, actions, and social rules to make richer stories mark their growing skills as a writer.

There is also much to be learned about the nature of mixed-initiative collaborative authoring tools. Players using this system should feel creative ownership over the stories they created using this system, while at the same time recognizing that these stories were made in collaboration with a digital writing partner. Discovering what relationship players have with the system—and with the stories they produce with it—will help inform the future development of this system and the development of other such tools.

Because *Writing Buddy* is still so early in its development, it is difficult to make any great claims towards its impact as a piece of shared authorship. It was specifically designed to evoke the pleasures of collaborative story-writing, it leverages technologies already proven to be capable of generating astronomical amounts of varied narrative content, but it also has built in mechanisms to encourage a semblance of well structured story (one of the key elements missing from *Prom Week*) without having to solely depend on humans to serve that purpose (as *Bad News* did). It should be abundantly clear for the player that they are engaged with a collaborator; by perusing almost actions, the player not only can see potential creative suggestions for directions the story could go in, but hopefully will also develop an understanding of the "thinking" of the system, better appreciating its contributions as a creative partner. There is less certainty that the system will be capable of fully recognizing the player as a creative partner. That is to say, though the system will be able to recognize the player's inputs and make new suggestions based off of them, for it to truly be a creative partner, it should slowly develop an understanding of the creative predilections of the player over time. In the short term, this could help the system to recognize the creative direction the player is taking the story in (though this would necessitate encoding substantial domain knowledge, as did *Prom Week*, and might limit the system to, say, only the particular genres that have been represented), and to make suggestions to make those directions come to pass.

In the longer term, however, I imagine a system that begins to recognize the creative disposition of the player, and attempts to push them outside of their comfort zone. This must be done gracefully and respectfully, of course—the primary responsibility of being a good writing partner is, first and foremost, being a good friend—but if done well, could potentially help fledgling authors break out of rote patterns and develop breadth to their authorial voice.

Though it is too early in *Writing Buddy*'s development to speak to this with any great authority, I would like to attempt to score the system as I envision it across the eleven design dimensions described in chapter 3.2. These scores can be seen in table 8.1.

	Human Collaborator	Performing Collaborator	Immersion	Simulation	Playtraces	Visible Collaborator	Reliable Collaborator	Game States	Space and Convergence	Visible Story Values	Cohesive Final Product
Writing Buddy	1	2	1	4	4	4	4	4	2	4	3

Table 8.1: Ranking an envisioned *Writing Buddy* across the dimensions of chapter 3.2.

Figure 8.2 will be our final look back on the design space, now with *Writing Buddy* included (note that, as *Writing Buddy* itself is still a work in progress, I label it as "Prototype" in the figure). Though early days, the intended design directions of the prototype appear to be moving in a positive direction for the cause of shared authorship; the prototype—like *Prom Week* and *Bad News* before it—is situated in the upper right hand quadrant. While *Bad News* was aligned all the way to the right, the prototype is pushing against the upper most border; it has similar deep simulation to several of the experiences previously discussed, with a very visible collaborator that takes no pains to present themselves as human. Though this will need to be revisited once *Writing Buddy* has been completed and placed in the hands of players, this is a good sign that its design is once again pushing on the boundaries of shared authorship.

I am optimistic that *Writing Buddy*—and other systems like it—will one day be the cornerstone of shared authorship, enabling players to create stories alongside a digital collaborator.

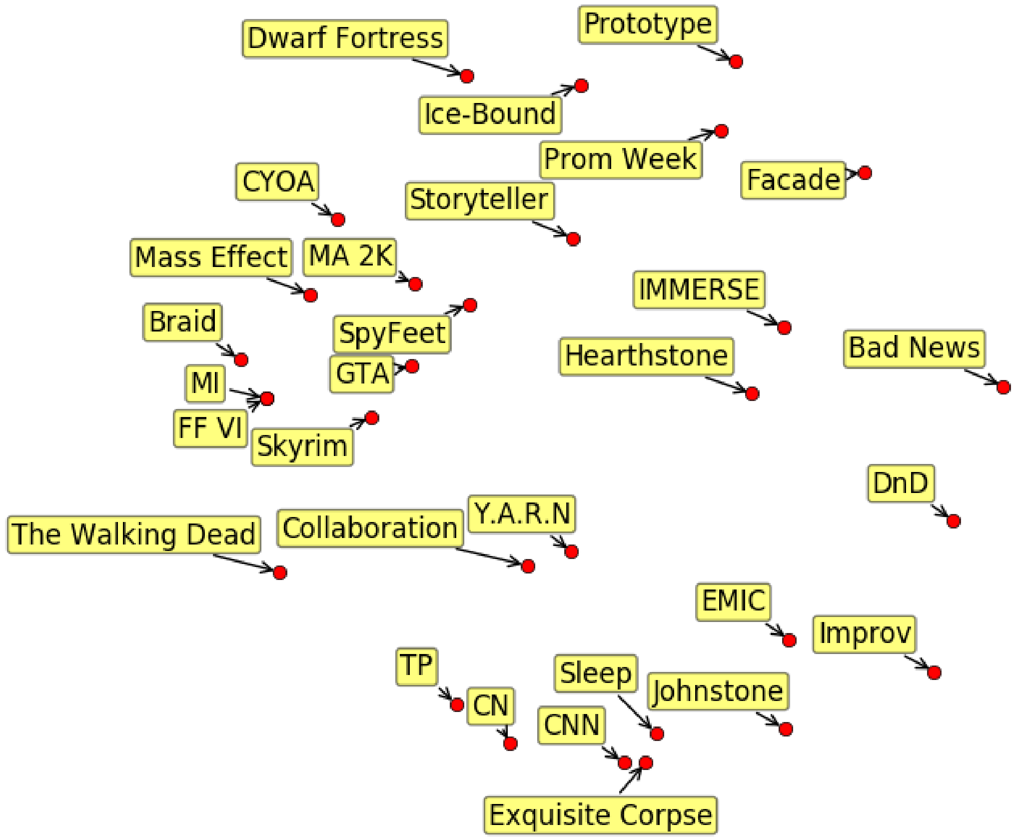

Figure 8.2: Our visualized design space first introduced in chapter 3.3, now with *Writing Buddy* included (marked as "Prototype" in the image).

8.5 The End

Well, gentle reader, it appears that at long last we have made it to the end. You have officially finished reading my dissertation, just as I have officially finished writing it. At this point, I'm not sure what else there is to say. We could reminisce on the good old days of chapters 1, 2, and 3 in which we first posited the notion of shared authorship. We could laugh about the joys we shared in chapters 4, 5, 6, discussing and evaluating *Prom Week* and the technology that enabled it. Or, perhaps we could think back on chapters 7 and 8 and delight over *Bad News* and *Writing Buddy*, my latest forays into the realm of interactive narrative. We could bask in all of these topics, and relish the notable advances each of them contributed to the cause of shared authorship.

Or, perhaps, lest we become devoured by hubris, you would prefer to be reminded of the many shortcomings of the pieces described herein. How *Prom Week* neglects one of the fundamental pleasures of shared authorship; that of the system learning about you as a collaborator. We could talk about how *Bad News*, the piece closest to achieving the dream of the holodeck [177], is only capable of achieving this dynamic and adaptive player-driven narrative system by relying on the storytelling and (perhaps more importantly) story-recognizing capabilities of a pair of humans donning the monikers of actor and wizard. Lastly, we must never forget that *Writing Buddy*, the piece most faithful to the idea of a digital collaborator and writing partner, is still in development and unproven.

Though it is valuable to temper pride with humility, please do not allow the preceding paragraph to depress you too much, gentle reader. The shortcomings of the pieces described herein merely speak to the exciting developments just waiting to be made in future pieces of shared authorship. Though I firmly believe that my work embodies several advances in interactive storytelling and shared authorship, I can only hope that others take inspiration from my pieces—just as I have been inspired by the works of so many others—to create interactive narratives in the truest sense of the term.

Even if the experiences I have discussed and created are not "perfect" pieces of shared authorship, I remind the reader that perfection was never the goal. Rather, I aimed to establish a vocabulary and design space with which existing and novel works of shared authorship could be described, my first of my two primary research questions. I then strove to use that understanding to present novel pieces of shared authorship and the technologies that power them; my second research question. With this baseline established, I am optimistic that the notion of shared authorship will continue to grow, and new nuances to the form will begin to emerge and crystallize through further research and development of playable experiences.

One such nuance that I'd like to posit before we say our farewells is a notion of shared authorship inverted to that which I've been discussing thus far. Up to this point, shared authorship has referred to multiple parties contributing their individual voices to create a story. However, there is an additional unexplored design space in which multiple parties relinquish their individual identities to form a mass which collectively steers the course of a story. Examples of crowd-based gameplay experiences already exist: Mateas' *Terminal Time* [142] (in which an audience collectively determines the agenda and bias of the presentation of historical footage), *Renga* [255], a piece named after a form of Japanese collaborative poetry in which a hundred players use laser pointers to steer a spaceship, collect supplies, and defeat enemies, and other installation based [224] or theatre-based [149] group games capable of being played by an audience. In another life this notion of an audience of players working together to determine a single narrative choice inspired me to write an interactive play. This play was never produced, and its branching narrative was no more sophisticated than a Choose Your Own Adventure novel, but even in that structurally simple piece lay the seeds that would eventually blossom into my vision of shared authorship.

Another example of this many-to-one inversion might be found in a reversal of a traditional role playing game. In many role playing games, such as *Dungeons and Dragons* [93] or *World of Warcraft* [179], players assume the role of a single character, and form parties with other player-controlled adventurers to delve into dungeons, slay beasties, and generally save the world. Rather than a group of adventurers form a single party, I'm fascinated by the notion of instead having a party of players assume command over a single adventurer. Were such a game to be made, safeguards would likely need to be embedded in the rules to ensure that every minute decision did not devolve into a committee argument, although an appropriate framing—such as the adventurer being racked by indecision thanks to suffering a multitude of roiling contrarian thoughts—might cleverly twist this potential weakness into a strength.

Another element of shared authorship that this dissertation has largely taken for granted is that—ultimately—it is the human player which is the consumer of the experience, even if the experience is inherently one of producing and collaboration. However, to truly explore the full spectrum of shared authorship, I think we will need to develop pieces in which the computer is intended to be the primary consumer. I realize that this might sound odd—or worse, like a premonition of a subservient human dystopian society—but believe me when I say that my bias towards human pleasure is still driving my thinking.

I outline in [249] a potential such game, in which instead of controlling an adventurer (or party of adventurers) and the computer is in charge of every other system (the NPCs the player speaks with, shopkeeper inventories, quest givers, monsters to slay, scheming bosses, etc.), the roles are reversed. The computer takes on the role of the hero of the story, and the player assumes control of every other facet of the game.

As I envision such an experience, the player's goal would not be to defeat the hero, nor would it be to facilitate their victory. Rather, the hero would have a perception of the game's difficulty level, amount of challenge, and their ability to succeed, and it is the player's responsibility to keep the computer controlled hero in a near constant state of flow. I believe that such a game would not only be a pleasurable experience in its own right—one need look no further than *Tomagatchi* [205], or the *Petz* series of games [279] for confirmation that humans can find pleasure in being the wards of virtual charges—but I also think that it could be a powerful avenue towards achieving one of the essential pleasures of shared authorship: understanding one's collaborative partner. By designing an experience that encourages players to design an experience for another—even if that other is virtual—I believe it could potentially foster empathy that could be transferred to other, more equitable, collaborative relationships.

And that, I believe, is everything. Let us end our time together the same way in which it began: with me thanking you, from the bottom of my heart, for taking the time to read this, my largest undertaking of solo-authorship to date. I hope, gentle reader, that one day you and I might be able to collaborate on a piece on interactive storytelling. I am sure it would be a piece of shared authorship for the ages.

THE END

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