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Comme il Faut: A System for Simulating Social Games Between Autonomous Characters

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ABSTRACT
Modern video games have highly developed computational models of physical space, which allow sophisticated play in the physical realm. However, computational models of social interaction are rare, offer limited social play, and require a large amount of authoring to create. We believe that a computational model of social interaction inspired by appropriate humanities and social science concepts could help alleviate these problems and open up new areas of social play. In this paper, we describe a playable model called *Comme il Faut* that uses a social artificial intelligence system particularly inspired by Goffman's dramaturgical analysis and Berne's psychological games, constructed for authoring power rather than fidelity with the everyday world. Our theoretical basis, the system's relation to other digital media and games, and its implementation are presented to explain *Comme il Faut* and our approach to enabling social play.

1. INTRODUCTION
Currently video games have achieved a high level of playability in physical spaces; combat, movement, and physics-based puzzles are all very playable and well modeled. Imagine a world in which social spaces are playable to the same degree as physical spaces currently are. A new and powerful set of playable media experiences could establish new genres of gaming and interactive art. The goal would not be to recreate the everyday social world, but to create social dynamics specifically crafted for use in media — just as platforming games don't reproduce the physics of the everyday world (but rather tune physics for gameplay) and fiction writers portray behavior and dialogue in stylized fashions that differ markedly from the average conversation.

The video game that is closest to offering a high level of social play is the experimental game *Façade* [14]. However, *Façade* is a game of limited duration that has only two well-defined social games (an "affinity game" and "therapy game"). Even with this limited scope, the authoring process for creating *Façade* was very time intensive and would not scale well to a larger game or a series of games. As we discuss below, other, more limited forms of social play exist in mainstream video games. These games typically have very limited forms of social play and, consequently, do not form a good foundation for moving forward toward more meaningful degrees of social playability. We believe strategic integration of humanities and social science concepts and domain knowledge can provide a path toward overcoming the limitations of these current approaches.

In short, to minimize this problem of authorial burden and to make social play experiences more varied, we need computational models of social space and social interaction that are as complex as their physical space computational model counterparts. This would make building social play experiences more tractable by allowing the system to manage the mechanics of the social space interactions, reducing the number of social interactions that need to be explicitly authored.

However, representing social interactions, cultural context, and the consequential interactions between the two in their entirety is an impractical, or perhaps impossible, task. The space of contexts and interactions is prohibitively large — and not necessarily the ideal one for authorial expression. As a result, our goal must be developing knowledge representations and architectures that are rich enough to support plausible social interactions, tractable to implement, and support authored variation.

In this paper, we describe a system named *Comme il Faut* that is a playable computational model of social interactions. Through a concept of social games inspired by Goffman's dramaturgical analysis [8] and Berne's psychological games [2], we detail the artificial intelligence (AI) system behind a playable model of social interaction. The design goal of this system is to represent and reason over compelling social situations along with the variations of the resultant behavior that arise from different personalities being placed in similar roles. The humanities, social science, and digital media foundations, inspirations, and key comparisons for the construction of *Comme il Faut* are explored below and linked to the architectural and implementation decisions behind this playable model.

2. RELATED WORK
Though there has been work exploring the social interactions between players in video games [12][5] less work has been done on enabling social play between players and characters driven by a social AI system. Some systems approach social interaction by modeling the social and emotional states of characters and using that state to determine characters' behaviors. For example, emotional responses of agents are simulated via appraisal dynamics by EMA [10]. Additionally, there has been work aimed connecting emotion to social qualities through social emotions and attributions [9].

Thespian [19] and the system it is built on, PsychSim [11], are multi-agent capable systems that model social interactions based on models of social influence. Each agent has goals, actions it can

perform, beliefs (including a recursive model of other agents), and mental models to increase the efficacy of the simulated agents' behaviors. The social interactions are based around the rules of social influence.

Some research has focused on social group interactions. The SGD (Synthetic Group Dynamics) Model of multi-agent social interaction is based on having each group member being aware of the other group members and of the group itself [16]. The SGD Model employs four levels of agent knowledge: the individual, group, interactions, and context levels.

FearNot! is an application of virtual drama aimed at anti-bullying education [1] that has similar themes to our architecture. Just as the concept of social games is informed by drama via dramaturgical analysis, FearNot! is inspired by drama in the form of Forum Theatre. The psychological model of appraisal is responsible for the agent's emotional and social changes during the course of the game. When FearNot!'s interaction is viewed in terms of social games, its internal structure is comprised of several social games: player introduction, interaction between the bully and a child, and the player giving the child advice.

Mascarenhas et. al. formalize rituals in order to generate culture-specific behavior for synthetic characters [13]. The concept of ritual was defined and integrated into a synthetic character architecture as a symbolic social activity that is carried out in a predetermined fashion. Expressed as a goal with a pre-defined plan, rituals were used to show that synthetic characters could act in culturally specific ways.

3. Theoretical Basis

The social AI system in *Comme il Faut* weaves concepts from the humanities and social sciences with existing AI, computer science, and software engineering knowledge to enable the possibility of creating a richly realized interactive media experience while taming the complexities of authoring socially believable characters.

The design goal of this system is to represent and reason over compelling social situations along with the variations of the resultant behavior that arise from different personalities being placed in similar roles. However, this design goal is extremely difficult given only tools available to computer science. Luckily, we can use knowledge from other fields to inform the design of the system. Of particular pertinence are the fields of sociology and psychology, and their subfields of micro-sociology and social psychology, along with knowledge of authoring and drama.

Though the system uses concepts from sociology and psychology as basis for models, the emphasis is not on deeply modeling or simulating social science concepts to create a fully accurate simulation of human behavior. Instead the focus is on implanting and exploiting the knowledge of human behavior accrued through social science to make the characters in *Comme il Faut* more believable and engaging, particularly in their social interactions. In this way, social science is used to create a playable model of social interaction to enable a new kind of player experience. The emphasis of the system is on *social games*, multi-character social interactions whose function is to modify the social state existing within and across the participants. In the same way that playable models of physics in combat games do not seek to model real physics, but rather take inspiration from physics to create a compelling experience, our playable model of social games does not seek to accurately model social cognition, but rather takes inspiration from a variety of social and psychological theories to create a model that underwrites compelling, playable experiences.

The remainder of this section explains the problems of implementing a social AI system. The areas in which the problems lie range across representing behavior and their contexts; the level of abstraction that the patterns of behavior should take; how to allow for personality specific variation of social behavior; and how to procedurally set goals for characters to follow. These problems will be addressed through techniques inspired by the works of Goffman, Berne, and Reiss.

3.1 Goffman

Goffman's concept of dramaturgical analysis views social interactions through the metaphor of a drama; actors, roles, props, setting, audience, and stage are all identified. This metaphor is particularly useful when modeling self-presentation, or the behavioral manipulation of how one is perceived by others. When social interactions are seen through this metaphor, the reasons behind behavior become more decipherable.

We applied dramaturgical analysis to interpret the situations and the actions taken by characters in the dramatic setting of the HBO show *Sex and the City* [15]. Our goal was to identify and explicitly represent dramatically interesting social games that can serve as a basis for our playable model. We focused on interpersonal dramas such as *Sex and the City* under the assumption that, for such dramas, the screenwriter is implicitly structuring the social interactions as dramatically interesting social games, making it easier for us to isolate compelling games than it would be performing a similar analysis on naturalistic interactions from everyday life. Individual interactions were viewed in terms of the roles taken by the participants, the setting of the interaction, teams composed of the participants, who comprised the audience, etc. With the interactions represented in this dramaturgical way, patterns became easier to distinguish within the drama. *Comme il Faut's* social AI system relies heavily on using dramaturgical analysis to capture *social games*, common multi-character behavior patterns that lead to social change

Dramaturgical analysis provides a method to capture these interaction patterns while keeping the normal social interaction and the context of the pattern intact. To show how this can be accomplished, we present an example of dramaturgical analysis applied to a set of social interactions in a scene from *Sex and the City* [21]. The setting of the performance is a wedding engagement party held in an expensive apartment in Manhattan. The audience consists of several dozen upper-middle class married individuals who are all in some way socially connected to the newly-engaged couple. The props present are objects typically found at celebrations: champagne glasses, tables, chairs, presents, etc.

The cast consists of two single friends, Miranda and Carrie, and a group of several female acquaintances, all of whom are married. Carrie and Miranda have two very distinct personalities. Carrie is an outgoing person who tends to directly face situations one at a time and is very focused on the role she is playing. Miranda, while being focused like Carrie, prioritizes the avoidance of bad things over proactively seeking her goals.

The scene begins and plays out in the following sequence of events. Carrie, Miranda, and the group of women are engaging in

conversation when the topic of relationships is brought up. The group of women discuss their current relationships. Eventually, the focus is placed on Carrie and she is asked about her relationship status. She states that she is single and content then passes the conversational back to the group. They then proceed to similarly ask Miranda about her relationship status. Miranda responds by going into a round of self deprecating jokes about her being single. She then excuses herself from the scene and exits the stage with Carrie; the scene ends.

When this scene is considered with the goal of determining social games from scene actions, a clear game is present in the previous example. The actions taken by Carrie, Miranda, and the group of women result in a social state change, altering what the group thinks of those who do not share a vital part of the group's identity (the identity of being in a relationship). Two characters, Miranda and Carrie, have the goal of using the actions in the scene to manage the impression that the group of women will form of them. We call this social game "not like the others."

This example illustrates an important concept related to dramaturgical analysis: impression management. Impression management is a goal-directed attempt at influencing the perceptions that are formed by others, which can be performed either consciously or unconsciously. It is not necessary for the subject of the managed impression to be the one performing the managing; the impressions can be of another person, event, or arbitrary object. When one manages the impressions of oneself, it is called self-presentation. Impressions are managed by regulating social information and interactions. Both Miranda and Carrie had the goal of self-presentation with regards to the group of women in the social game.

The context of the episode around this scene from *Sex and the City* shows the compositional nature of performances in the dramaturgical metaphor. Because Carrie and Miranda are friends of the groom-to-be, they are playing a social game of supporting their friend's engagement. The example, therefore, is an event in the larger social game of supporting a friend. Furthermore, by planning to go to the party together, Carrie and Miranda are playing a social game of mutual support while simultaneously playing the example social game.

3.2 Berne

Dramaturgical analysis does well at representing patterns of normal social behavior and their contexts. However, the range of interaction patterns that the dramaturgical metaphor can encompass is very large: rituals, life-long performances, and simple conversations all fit into dramaturgical analysis. Both the lifelong performance of playing the unfortunate victim of fate and the short-term, routine performance of purchasing lunch from a street vendor are amenable to dramaturgical analysis. Though each example is a pattern of social behavior with social state change and contexts in which they are considered normal, the experience a player would have participating in the social behavior in each case is very different. While short-term, routine performances have been the focus of games such as *The Sims* and *The Sims II*, our focus is on creating a playable model of more dramatically interesting and intense social behaviors.
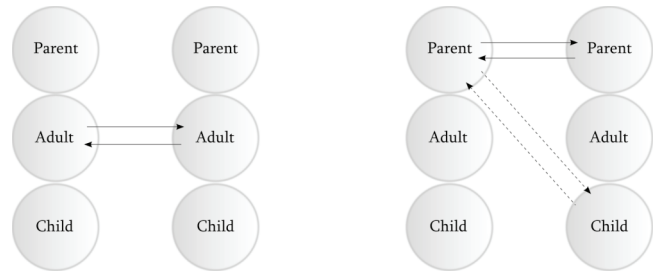

Figure 1. Two different relationships between ego states in transactional analysis are portrayed in this diagram. To the left is a complementary transaction. To the right is an ulterior transaction where the social interaction is represented with solid arrow lines and the psychological is dashed.

Berne's theoretical framework for transactional analysis makes a clear distinction between these, and other, patterns of normal social behavior [2]. By classifying interactions into transactions, procedures, rituals, pastimes, and games, Berne categorizes patterns of social interaction by their complexity. Part of this complexity is based on 3 ego states or roles — parent, adult, and child — that the participants in the interaction take. If the participants both take on the expected ego states for an interaction, it is called complementary. A transaction is the basic unit of social intercourse and is based on the participants having a complementary interaction. A procedure is a set of these complementary transactions, while a ritual is like a procedure that has been stereotyped and programmed by the culture in which the participants reside. Pastimes are a series of simple, complimentary transactions that have ritualistic qualities. They are used to structure time while maximizing the social benefit to all involved. The time interval of a pastime is typically started and ended by a procedure or ritual. Examples of pastimes include: "Man Talk," "Lady Talk," "Small Talk," "Ever Been" (to a nostalgic location), and "Morning After." As the names suggest, pastimes are commonly used in social gatherings such as parties.

Social games have their best fit in Berne's notion of game: a series of complementary ulterior transactions that are ongoing and organized into a predictable, well-defined outcome. One of the important distinctions that link Berne's game with our dramaturgically inspired social games is ulterior transactions. When the superficial, social ego states of the participants are in one interaction mode but the deeper, psychological ego states are in a different interaction mode, the transaction is considered ulterior or covert (see Figure 1). Consider a transaction where a boss says "Could you please work Saturday?" to an employee. The common work ethic and the boss' body language both clearly state that such a statement is an order to work over the weekend and not a request. The employee responds by saying "I had made plans for the weekend but I'll work Saturday this one time." Through simply hearing the words, the transaction seems to be adult-to-adult request and response. When taken in context, however, the nature of the transaction is one of parent-to-child: the demanding boss is playing a parent role and the employer is taking a capitulating, child-like role. The difference between the surface and the parallel conversations in the example makes the transaction covert or ulterior.

As this distinction allows for the decoupling of the superficial interpretation from the psychological and sociological change of
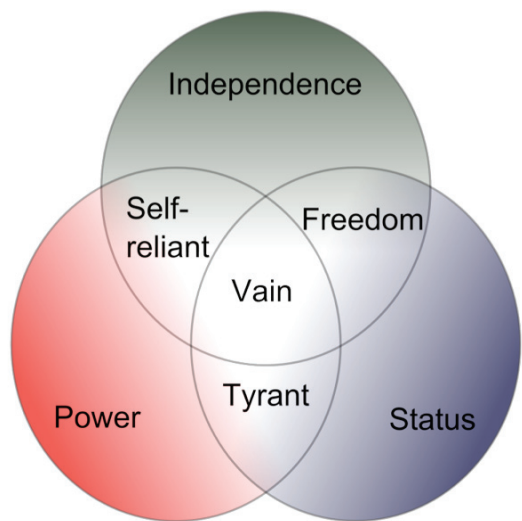
Figure 2. This diagrams shows how the combinations of the basic needs independence, power, and status combine to create the compound personality traits of self-reliant, freedom, tyrant, and vain.

interaction, ulterior transactions capture the coupling of interactions and cunning self representation that social games wish to utilize. Examples of Berne's social games are "Corner" (manipulate another so that all their actions are wrong), "Tell Me Your Problems" (get an admission of weakness), "Sweetheart" (ridicule another in public to feel superior), and "Wooden Leg" (elicit sympathy to cover up irresponsibility or bad decisions).

Berne has assembled a catalog of games that are easily adapted to dramaturgical analysis. The cataloged games were inspired by his experience as a psychotherapist and are described in terms including a space of transactions, number of players, and psychological needs. Also described are variation in the game based on the personality and specific culture of the participants, providing us with guidance on the amount of variation to include within individual games in our social AI system.

When considering this personality-specific variation when characters perform a role, some problems arise: why should characters participate in the performances they do and what factors influence the outcome of a performance by one character as opposed to an other? Berne provides a partial solution in his attributes used to classify games. Clinical types, psychodynamics, and instinctual descriptions of games provide a view into the psychological needs of those who perform. But Berne's categories of psychological need are still too abstract to effectively inform the design of our AI system. This is where we turn to the work of Steven Reiss.

3.3 Reiss

Reiss' work on motivation analysis [17] provides a conceptual continuation from Berne's games and their psychological needs. Based on an analysis of the nature of basic desires, psychological needs (also known as basic needs or life motives) are a set of 16 basic desires that need to be fulfilled. After being satiated, the desire to fulfill the basic need grows at a rate tied to the intensity

of the need. Emotions can be seen as a gauge for how well these basic desires are met: positive emotions imply a well satiated individual while negative emotions suggest unmet basic needs.

Motivation analysis correlates basic needs and their intensities, both high and low, with personality traits (see Table 1). Additionally, separate basic needs can cause the same trait or they can combine to create a compound trait as can be seen in Figure 2. For example, the *non-conformist* trait can be caused though a character having a strong intensity of the *independence* basic need or a weak intensity of the *status* basic need. The compound trait *distrustful* requires strong *independence* and weak *honor*. A personality profile consists of combinations of a person's intensity values for each of 16 basic needs in addition to their traits. Some common strong and weak sets of basic needs that dominate personalities have been explored with respect to normal behavior. Reiss has identified the behavior patterns of several standard personality types: workaholic, competitor, humanitarian, thinker, romantic, longer and ascetic.

Table 1. The 16 basic needs with example traits for their positive and negative strengths.

Psychological/Basic Need	Example Strong Desire Trait	Example Weak Desire Trait
Acceptance	Self-doubting	Self-confident
Curiosity	Intellectual	Practical
Eating	Overeater	Fussy eater
Family	Devoted Parent	Absent Parent
Honor	Principled	Opportunistic
Idealism	Humanitarian	Looks other way
Independence	Stubborn	Interdependent
Order	Organized	Flexible
Physical Activity	Energetic	Lackadaisical
Power	Take-charge	Laid-back
Romance	Romantic	Platonic
Saving	Collector	Extravagant
Social Contact	Extroverted	Introverted
Status	Formal	Informal
Tranquility	Timid	Brave
Vengeance	Competitor	Peacemaker

Motivation analysis has picked up and filled in the detail where transactional analysis stopped. Psychological needs are linked to motivation, which provides an ontology for reasoning about why actors perform as they do. Those with strong positive or negative basic needs may possess traits. Traits require certain strengths and/or combinations of basic needs as a basis for the character to be sensibly given a particular trait. Though traits are derived from basic needs, the derivation is not automatic; basic needs serve to open up the possibility of a trait being present in an individual. Whereas basic needs are broad indicators of behavior, traits

describe a proclivity toward stronger and more narrow behavior patterns.

Common personality profiles are identified and form the basis for normal personality types. This connection of basic needs, traits, motivation, and personality type analysis allows for a sensible coupling of personality descriptions with social change. This coupling is present in our AI system as goal selection (choosing which basic needs and traits the character would like to satiate) and intent formation (choosing a social game to play from all available social games that satisfy goals), discussed further in the social AI system architecture section.

4. Social Games and Digital Media

Figure 3 depicts a character design space, with one dimension representing the dynamism of the social space the characters inhabit, and the other dimension characterizing the richness of realization of the characters. To position the representation of social games used by *Comme il Faut* in this space, the extremes will be defined in terms of existing media examples. Social games will then be placed in relation to the examples.

4.1 Mass Effect

At the extreme of rich character realization and small space of social dynamics are video games with limited options for interaction between characters and players. The computer role playing game *Mass Effect [3]*, one of the most praised recent games in its genre, is a good example of this extreme. The characters are fully realized — they are individuals, with idiosyncratic responses to situations, with histories that matter, and with beliefs and attitudes and reputations that change based on events in the game world. One can imagine many ways of implementing such characters. But *Mass Effect* (like most contemporary games) implements them through brute force human authoring. Some games simply do this the way that a movie or novel does it — by writing one canonical sequence of events that always happen to the characters, revealing who they are. Games like *Mass Effect* take a further step — different things can happen, and the characters respond to these differences meaningfully. But because of the development approach (of brute force authorship of character behavior in each state and hand-authored state transitions, which is extremely time consuming and bug-prone to produce), *Mass Effect* must have a very narrow band of possible variation.

The dialog system is a standard tree type that allows for only a limited set of social choices. Further, only the player can affect the social state, as any social change that happens in *Mass Effect* is the result of a scripted reaction to an in-game decision of the player. Certain actions can be taken in a "paragon" or "renegade" manner, and doing this consistently enough will open otherwise-unavailable dialogue/action options. Affinity can be developed with characters, which can open certain new missions and can, in one case (Wrex), determine whether it is possible to keep a character alive longer in the game. But even some of the level of relationship complexity of BioWare's earlier *Star Wars: Knights of the Old Republic* (*KotOR*) [4] is removed. For example, while *KotOR* allows players to develop relationships with their team members in any context, threading this relationship development through the course of gameplay, *Mass Effect* limits this to shipboard interaction — even though the majority of gameplay takes place off the ship.
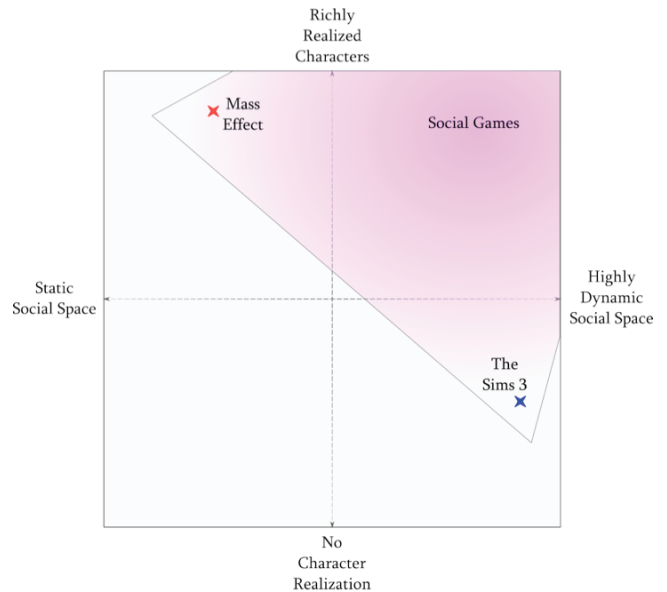
Figure 3. The area in the space of video games that social games may enable in terms of character realization and possible social dynamics available to players and characters is shown in purple. Reference examples are *The Sims 3* (blue marker) and *Mass Effect* (red marker).

Perhaps the most dramatic choice in *Mass Effect* involves a dilemma. The player character has two team members in dire peril and can only move quickly enough to save one of them. Both selflessly urge the player to save the other. Whichever dies, there is mourning upon return to the ship and reference to that person's loss in later dialogue. Unfortunately, the game undercuts the power of this choice and its aftermath by forcing the player to use two particular team members for the mission, even though most missions in the game allow for a free choice of team members. The choice is forced because it would be too great an authorial burden to write character-specific actions and responses for every combination of the dilemma and every possible period of mourning. But this means the dilemma only operates like an organic part of the experience for players who happen to regularly play missions with the two characters that have hand-scripted options for this particular mission. Given that players have six team members available, only a small minority are likely to have selected this pair regularly. A system such as the one we describe, on the other hand, doesn't run into such problems.

When compared to *Mass Effect*, *Comme il Faut* has a much larger social space available to not only the player, but to every social character in the game. It provides a set of normal social behavior patterns, or social games, that provide an avenue for social entities to bend the social state according to their machinations. It is a framework in which characters have personality-specific variation in how they play and select social games, can develop history continually through play (which can be employed in future social interactions), and can alter their reputations and attitudes continually along multiple dimensions. Though the characters in *Mass Effect* derive power from their hand-authored nature, the approach of such games is not an appropriate foundation for our goal of making social interaction the highly-varying center of playable media experiences. We believe a better path lies in

beginning with a foundation such as *Comme il Faut*'s, in which rich characters can be dynamic and playable, and then seeking means for authors to integrate more specifics of language and behavior for individual characters.

4.2 The Sims 3

The Sims 3 [6] is an example of a culturally influential and commercially successful video game that has a highly dynamic social space. Its characters, known as Sims, have traits and desires that inform the social practices they perform. Social practices are explicitly modeled after social norms, which are represented as hierarchies of clusters of expectations [7]. These practices have both a regulating and constitutive affect on character behavior: they help specify how an agent should not behave as well as enable new behavior and intentions. A Sim can be involved in more than one practice at a time and a practice can involve more than one Sim at a time. This enables Sims to experience conflicting goals and intentions, which is a capability shared by social games.

One major difference between our concept of social games and social practices in *The Sims 3* is the scope of the social choices they cover. In *The Sims 3*, practices represent patterns of behavior consistent with Berne's notion of rituals. Visiting and Bedtime are captured as practices and consist of shorter rituals or even pastimes such as "invite guest in," "socialize," or "farewell." When a Sim takes a role in a practice, he/she can either follow the described normal behavior or, possibly due to a conflict, break the normal expectation and suffer the consequent reactions from the other Sims involved in the practice. In comparison, social games are built to provide characters explicit choice over changes in the social state. "Now I've Got You, You Son of a Bitch" (calling out others when they wrong you) and "Alcoholic" (pursuing self-destructive behavior for attention or sympathy) are examples of the lifetime patterns of social change captured by social games. The sense of normal behavior in these social games consists of playing the roles according to the game or acting antithetically to halt the expected social change.

Each Sim has traits that represent the Sim's personality and, in turn, influence the goals of that character. Examples of traits in *The Sims 3* are kleptomaniac, clumsy, conversationalist, hot-headed, materialistic, and schmoozer. The goals of the Sim range from short to long term (such as lifetime wishes like "Become an Astronaut") and are determined through a combination of available social practices, the character's traits, and the current environment. The scoring of the psychological and social state of a Sim is done through a happiness score. Happiness is accrued by allowing the Sim to take part in practices that are consistent with their traits and goals. In effect, practices, traits, and their derived goals are all employed to create a vehicle for a player to direct a Sim to higher scores of happiness. In contrast, *Comme il Faut* uses social games and personality descriptions to generate behavior consistent with social norms; allows personality specific variation in game play; and allows social games to be played for opportunistic state change by characters though the subversive qualities of Goffman's dramaturgical metaphor. Goals derived from the personality description and input by an author are meant to facilitate drama and believability — quite different from maximizing a happiness metric. If the use of social games were limited to increasing a happiness metric, the subversive qualities of playing social games for reasons like revenge or self

destruction would be lost; interactive experiences with themes that are grounded in "unhappiness" (like suicide, greed, or lust) would be inaccessible. And, even if these were somehow redefined as happiness-producing activities for certain personalities, the approach of *The Sims 3,* while highly dynamic, is largely focused on the immediate, even the physical. There is no obvious path in the approach of *The Sims 3* toward the kinds of meaningful character histories that we believe are essential for richly realized characters. For these reasons, *Comme il Faut*'s social AI system allows for a wider range of goals and motivations and clearer path toward meaningful socially-focused play.

5. Social AI System Architecture

The social AI system of *Comme il Faut* was engineered to produce playable models inspired by the previously described concepts from the social sciences together with humanities-derived understandings of drama, fiction, and authoring. The two categories of system entities are data representations of character knowledge and process representations. Social games, personality descriptions, and social state are the data the system stores. Goal setting, intent forming, social game negotiation, and performance realization are the processes though which the data is modified during system execution.

5.1 Social Games

Inspired by Goffman's dramaturgical analysis, we employ a representation of social interactions as drama-based social games. A social game is a multi-character social interaction whose function is to modify the social state existing within and across the participants, possibly concurrently accomplishing a functional (non-social) state change. Social games are represented as composite data structures consisting of dramaturgical precondition statements, social state change statements to be enacted on game completion, and a dependency graph of events. The nodes that comprise the dependency graph consist of social game events that encode the performance actions, social state change and functional or world state change that, when taken as a whole, describe the mechanics of a social game. The events at which the dependency graph branches represent choices between the sets of social state changes present in events that comprise the resultant subgraph (see Figure 5). Ultimately the goal for social games is to produce characters that behave with the same personality and dramatic qualities as the characters in fictions such as *Sex and the City* — reasoning over and exploiting the social environment in a way consistent with the dramaturgical metaphor.

The dramaturgical preconditions consist of a list of roles and their requirements, qualities needed in the setting, teams among the actors, and conditions on the audience (the characters watching a social game, but not participating in explicit roles). Dramaturgical preconditions can be either a fact precondition or a relation precondition. Fact preconditions state a fact about a dramaturgical entity: "Prop piano" or "setting romantic" are examples of fact preconditions. "Bill brother Ted" or "Joan spouse Ranjit" are relation preconditions, which relate two dramaturgical entities with a relation type.

Social game events are composed of a list of participating actors, temporal properties, actions taken by actors, functional world change, and social facts modified by the event. Because the social effects of a social game can be different than the sum of the changes specified in its events, the state change upon a game's

successful completion is also represented. Events contain one or more performance actions (which are queued to the performance realization service), social state change or traits that result from completing the event, and, if applicable, which role chooses the next event. Figure 5 provides an example event structure for a social game.

The event graph of a social game makes use of two link types: standard and antithetical links. The standard links represent the normal way to play the game while antithetical links represent Berne's antithetical game moves. When two links lead out of a social game, a choice must be made between the two paths. The role responsible for making the choice is marked in the event where the choice is to be made. One event is marked as the start event of the social game.

5.2 Personality Description
Social games only capture a portion of the variation in performance required to guide agents in social interaction. Descriptions of the agents' personalities with regards to actor-specific variations in performance are needed to guide the agent through the possible performance outcomes specified by the social game representation. The personality description consists of information that facilitates the process of choosing which social games to initiate, which to participate in, what roles to perform, and which paths through the dependency graph of social game events are preferred. The personality description includes the initial social state of the agent, performance tendencies, which of the social games in the social game library the agent prefers to participate in, and goals in the form of social states to be reached. The following is an example of a character's personality description in the XML form recognized by *Comme il Faut*:

```
</character>
 <character name="ted" type="humanitarian">

 <need intensity="0.1"  name="acceptance"/>
 <need intensity="-0.1" name="curiosity" />
 <need intensity="0.0"  name="eating" />
 <need intensity="-0.8" name="family" />
 <need intensity="0.3"  name="honor" />
 <need intensity="0.75" name="idealism" />
 <need intensity="0.2"  name="independence" />
 <need intensity="-0.2" name="order" />
 <need intensity="0.1"  name="physical" />
 <need intensity="0.2"  name="power" />
 <need intensity="-0.1" name="romance" />
 <need intensity="0.0"  name="saving" />
 <need intensity="-0.2" name="contact" />
 <need intensity="0.1"  name="status" />
 <need intensity="-0.9" name="tranquility" />
 <need intensity="0.8"  name="vengeance" />

 <trait name="angry" />
 <trait name="philanthropic" />
 <trait name="uninhibitied" />

 <tendency game="Kick Me" />

 <goal subject="ted" topic="friend" object="bill"
volition="0.3"/>
</character>
```

Ted, the character whose personality is described, has the humanitarian personality type (a personality type described by Reiss). The 16 *need* XML tags each specify the name of a basic need and the intensity of that need. When taken as a whole, the need XML tags constitute the basic needs profile of Ted. He has strong basic need intensities for *idealism* and *vengeance* and has weak intensities for *family* and *tranquility*. He also has traits

associated with his basic needs profile: his *anger* trait is based on the *vengeance* basic need; *philanthropic* is based on his strong *idealism*; and *uninhibited* is based on his weak *tranquility*. The *goal* XML tag represents a goal given to the character by the character's author (in this case the goal is to make Bill your friend). These author goals allow for a degree of fine-tuning the direction of changes in the social environment and helps facilitate the creation of dramatic situations.

The variation in social game play based on personality can potentially manifest anywhere in the agent decision making process – from the highest levels of goal setting down to the smallest details of behavior realization. As this architecture is focused on goal setting through social game formation, the personality description will encompass what is needed for goal setting, intent forming, and, to a lesser extent, role negotiation (which is detailed in the social AI process description).

5.3 Social State
The social state in *Comme il Faut* consists of the current social state and a history of past social events. Social facts are the basic units of the social state. A social fact can either be a basic need fact or a social status fact. Basic needs facts consist of a subject, a basic need, and a numeric value indicating the event's impact on the basic need. An example is "Bill independence .25". Social status facts, expressed as triples of strings that specify the subject, fact, and object, encode relationships between characters in a binary way. An example is "Bill friend Ted". Social status facts can use wildcards to quantify over all characters in the environment. For example, "John DJ *" represents the social status fact that John is the DJ at the party (he has the DJ relationship to every character).

The current social state consists of an array of references to the current fulfillment levels of the basic psychological needs of each character and a list of which social status facts are currently in effect. The history of past social events is a time-ordered database that keeps track of what social games were played, who played them, and what social status facts were modified or added during social game play.

5.4 Process
To leverage these data representations of character knowledge, we provide a framework (see Figure 4) that uses personality descriptions and a social game library to select agent actions and produce social state changes consistent with those actions. This framework is composed of the goal setting processes, the intent forming process, the game role negotiator, an agent-specific database of social facts, and a database of annotated social games. Agents participating in the system follow this process in parallel with one another.

5.4.1 Goal Selection
Goal selection is called on a per-character basis and serves as a starting point for an iteration of the social AI system. As the act of fulfilling a basic need is considered a goal by motivational analysis (see Reiss' Principle V) [17], goal selection uses the current state of fulfillment of the character's basic needs and the character's basic needs profile, producing a set of pairs of goals and volitions. Volitions are a value associated with goals that represent the character's desire to complete that goal. Goal volitions are used to compare goals and determine which goal to

send to the intent forming services. Additionally, author goals in the personality description have volition values and are compared alongside the goals generated from basic needs. The basic need or author goal with the highest strength has a greater probability of being acted upon by being selected for intent formation.

The character keeps track of the current state of need for each basic need. These values have a range of [0.0-1.0] where 0.0 is satiated and 1.0 is maximum need. Each of the basic need volitions are calculated at any given point in time by taking the absolute value of the intensity level multiplied by the
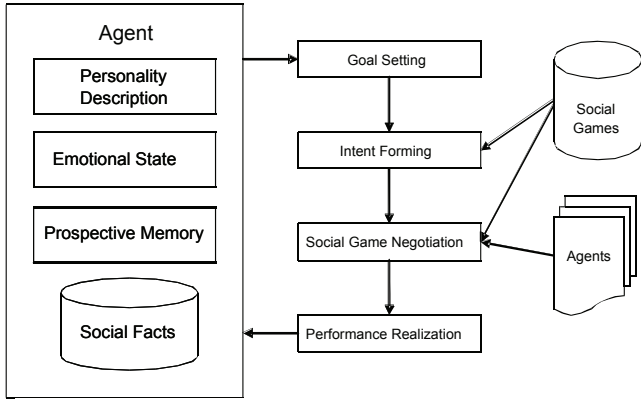
Figure 4. The process flow of *Comme il Faut*'s social AI system.

current state of fulfillment. The higher the result, the more need there is for that basic desire. The volition values of author goals are taken directly from the personality description. The volitions are used to form a normalized probability distribution from which a goal to send to the intent forming service can be chosen. Varying the methods used to create the probability distribution (such as more heavily weighting the goals with higher volitions with respect to those with lower volitions) can be used as another point of customization in a personality description. The volitions and the probability distribution are stored in prospective memory, which is that data structure's only duty.

5.4.2 Intent Formation
Intent formation is the process of choosing a social game from the social game library that fits the goal identified during goal selection. The first calculation done by intent formation is to determine if the character is ready to initiate a social game. This check controls the pace of social interaction and makes the rate at which a character starts social games part of his/her personality description. The rate at which a character initiates social games is proportional to the volition for the *social contact* basic need.

Just as goal selection produced a probability distribution over goals as a function of volition, intent formation produces a probability distribution over roles in games based on how well the role satisfies a goal. This process of scoring games according to a specific character and their goals is characterized by the following equation:

$$I_{c,g,r} = \sum_{e}^{eventsG} [\sum_{b}^{B} strength(b,e)V_{c,b} + \sum_{t}^{T_e} V_{c,t}]$$

This scoring function is called for every role in every social game in the social game library during a character's intent formation process. Each call to the scoring function produces a numeric

value $I_{c,g,r}$ which is the intent of character c to play game g as the role r. For every event e in g the intent contributed by basic need and trait goals is calculated. The function *strength(b,e)* refers to the fulfillment value of the basic need b provided by event e with respect to role r. This strength is multiplied by $V_{c,b}$ which is the volition of the basic needs goal of basic need b for character c. For all traits t fulfilled in the event, the volition of the goal associated with that trait, or $V_{c,t}$, is added to the score.

With an intent score for every role in every game in the social library for the character who called the intent forming process, a probability distribution can be generated. Similar to the process of creating a probability distribution for goals during goal selection, the intent distribution can be constructed with a different weighting scheme according to the character's personality description. A role and social game are then chosen from the distribution and are given to the role negotiation process.

5.4.3 Role Negotiation
After a character chooses a game and a role within that game they wish to initiate, the role negotiation service is invoked. This service coordinates the process of filling all open roles in the chosen social game with characters. The result is a social game that has a willing participant and is ready to be realized.

Unlike goal selection and intent formation, all agents participate in every role negotiation process. The first task of the role negotiation service is to give the initiating character his/her choice of role. Then every other character in the system forms their intentions over the remaining roles. This is done through running a smaller, more specialized version of intent formation which only scores the roles in the initiated game for a character (instead of score every role in every game for every character). After the scoring is complete, the roles are assigned to characters by descending intent values. The concept modeled through the specialized intent formation process is the taking of roles in social games initiated by others to opportunistically fulfill goals without initiating games oneself. This matches the subversive and self-service use of roles in performances enacted by others identified in dramaturgical analysis theory.

This portion of the system has great potential for interesting complexity as it is where the characters and all of their personal goals and personalities clash to determine if a social games is acceptable and what roles they are willing to take or be placed in. A great deal of detail could be put into algorithms that model the strategic and subversive world of self presentation in each agent. As such, the role negotiation service has interesting areas in which to expand in the future.

5.4.4 Performance Realization
Performance realization manages the details of instantiating the actions of the characters during play, based on context and personality specific factors. In the current incarnation of *Comme il Faut*, the focus is on the AI system and not the performance realization. A debug version of the system uses simple text output to display the performance actions and the social and psychological state changes. For the game we're currently creating, the performance system consists of 2D graphics.

Social Game: "Kick Me"
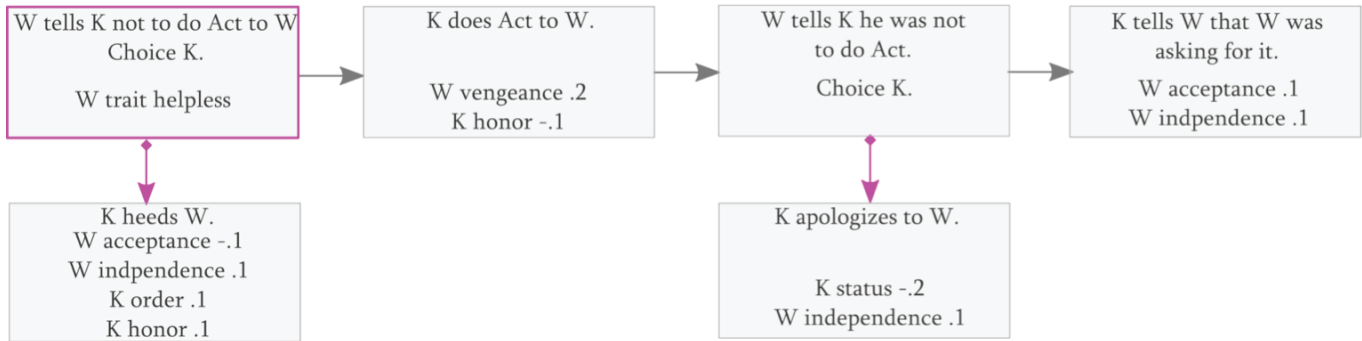
Figure 5. The dependency graph of events comprising the social game adaptation of Berne's "Kick Me" game. The roles are W, or "white", and K, or "the kicker". Each box is an event. The top left box is the initial game event. The arrows indicate the progress of events through the game. Where a box has two arrows leading from it, there is a choice to be made. The role that makes the choice is indicated in the event. The purple arrows that begin with a diamond indicate antithetical choices.

5.4.5 Example of Process

Consider two characters, Bill and Ted, each with personality descriptions. Ted's personality is described in the personality description section. Bill has a normal personality type of "Thinker" which gives him strong basic need intensities in *acceptance* and *curiosity* and weak intensities in *family, romance, and social contact*. Based on his strong intensity in acceptance, he also has the trait *helpless*. The social library consists of the "Kick Me" (see Figure 5) and "Sweetheart" games.

The social AI system begins by setting goals for both agents. Since there is no history in the social state, the characters' volitions are set to the basic need intensity values as depicted in their personality descriptions. Because Bill has a higher intensity in social contact than Ted, Bill proceeds to intent formation. Intent formation scores the roles in the "Sweetheart" game low with respect to Bill as that game features the "dominance" trait and weak honor basic need intensity. However, due to Bill's "helpless" trait as well as his high acceptance basic need intensity, he scores a high intensity with the W role in "Kick Me."

As the W role in the "Kick Me" game is Bill's highest scoring game/role combination, he claims the W role and starts role negotiation with "Kick Me." Since Bill has claimed role W, role negotiation has Ted perform intent formation to score the unclaimed roles in "Kick Me." Since it is the only unclaimed role left in the game, Ted claims the role K.

Since the social game has been selected and the roles claimed, "Kick Me" with Bill as W and Ted as K is sent to performance realization. The first event is processed and results, in the debug version of the system, in printing the performance action "Bill tells Ted not to do Act to him" and presents Ted with the choice of which event to process next. Since Ted has a high volition for his vengeance goal, he chooses to ignore the antithetical link and play the normal version of "Kick Me." The next event outputs the performance action "Ted does Act to Bill" and processes the social state change of "Bill Vengeance .2", which raises the

current strength of Bill's vengeance basic need by .2. Since there is no choice for this event, the performance realization moves to

the next linked event. The event outputs "Bill tells Ted that he was not to do Act." Ted is then presented with the choice of being antithetical and apologizing to Bill (which results in lowering Ted's status) or to continue with normal performance (which helps to satisfy his goals by increasing acceptance and lowering independence); Ted chooses the normal path. Now the last event is processed, printing "Ted tells Bill that Bill was asking for it." The social state change associated with the last event adds .1 to Bill's acceptance and lowers his independence by .1, both of which have high volition in Bill's prospective memory. The game is now over, the social state is updated, and another iteration of the social AI system can begin.

6. A PLAY EXPERIENCE

We are currently in the design stages for an experimental game employing *Comme il Faut*. A player is presented with a game area resembling a slightly twisted high school prom. At the center back of the room is a table on which the AV equipment for the event resides. Gathered equidistant from the AV table on opposite sides of the room are two groups of high school students. To the left, near the windows that are framed by strands of holiday lights, are the emocore. To the right, next to the snack bar, are the Goths. Both groups are focused on the silent AV equipment and the AV club member who is fiddling with the audio wires and controls. A sign above the AV equipment says, "Welcome to the Alt-Prom." The AV club member manning the audio equipment asks, "Um… I still have some work left before the audio gear is ready to go; who has the play list for tonight?" With this, the stage for the battle of the playlist for the alt-prom is set.

After the introduction, the individual characters in the emocore and goth groups begin to play exaggerated social games with one another in personality-specific manners driven by *Comme il Faut*. After each game, the affinity with the AV club member with respect to either group is changed; the AV club member is an audience member to the social game performances taking place. *Kick me* could be played by a self-victimizing emocore member with a member of the goth group. This may result in the affinity with the AV club member noticeably diminishing with respect to goths when the goth picks on the emocore member as described in

Kick me. Observing such dynamics allows the player to begin to understand what makes an impression on the AV club member.

In parallel with the AI-driven social gameplay of the characters, several cards with listed titles and game effects pertinent to the social state are given to the player. When selected by the player, the cards' effects change the social state of the game world, which affect the social games played by the two groups of characters. The player is dealt cards such as "Angst," which increases the level of vengeance of a character, and "Restless Soul," which provides a boost to a character's highest basic need value. These cards are used by the player to encourage behaviors that, in turn, alter the possibility space for future games and influence which group will have eventual control of the playlist. A sandbox mode allows free experimentation with the social space, while a competitive mode invites play on behalf of one group. Played cards are periodically replenished with new, freshly dealt cards. After a few minutes pass, the audio equipment is ready to be used—but, in the meantime, the high-stakes social play has altered the lives and personalities of a number of teens (e.g., causing traits to dramatically emerge or dissolve). The group with the highest affinity with the AV club member has their playlist selected as the official playlist for the alt-prom, providing a backdrop for a review of the night's social highlights.

7. CONCLUSION

In this paper, we have described the theoretical foundation for the social AI system in *Comme il Faut,* based on linking the theories of Goffman, Berne, and Reiss. Then the system was discussed in relation to the media qualities of social space and character realization, with *Mass Effect* and *The Sims 3* as reference points. Finally, the system was described in terms of social games, personality descriptions, social state, and the goal selection, intent formation and performance realization processes. An interpreted trace of the system was given as an illustrative example and our in-process experimental game was described.

The social science, humanities, and media foundations and inspirations for the construction of *Comme il Faut* are linked to the architectural and implementation decisions behind this playable model. It has design goals to represent and reason over compelling social situations while allowing for personality specific variation in behavior and opportunistic play.

In future work, we plan on enriching the personality description and adding more sophisticated functionality for goal selection and intent formation. In particular, the intent planner can do more intelligent look-ahead on the events of a role and take antithetical branches into account when picking a game and role to send to the role negotiation process. In addition, we wish to hook the system to a stronger performance realization engine. In particular, work that can take social context into account [20] offers powerful synergies with the approach of *Comme il Faut.*

8. ACKNOWLEGEMENTS

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