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Being Non-speaking in a Speaking World: Surfacing the Improvisations of Autistic Individuals

by

Rachel S. Y. Chen

A dissertation submitted in partial satisfaction of the

requirements for the degree of

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in

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in

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in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:
Professor Dor Abrahamson, Chair
Professor Betty Yu
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Abstract

Being Non-speaking in a Speaking World: Surfacing the Improvisations of Autistic
Individuals

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Doctor of Philosophy in Special Education

University of California, Berkeley

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In our speech-centric, hearing-privileged world (Savarese, 2022), the production of
oral-acoustic speech and the ability to hear the speech of others are often prerequisites for
social participation. In like vein, to carry the diagnostic label of "Autism" is to be clinically
characterized as having a deficit in social communication (DSM-5, 2013). Augmentative
Alternative Communication (AAC) has been touted as solution for non-speaking autistic
communicators (Mirenda, 2008). Yet, even in the therapeutic realm of AAC, speech is
privileged.

Non-speaking autistic individuals have unique communicative practices, and their
differently disposed neurotypical interactants may experience surprise or even chagrin
(Maynard & Turowetz, 2022) when they perform social actions that are not 'typical' (Milton,
2012). However, every living being is in constant attunement with the world (Merleau-Ponty,
1962), invoking the social and material environment in various ways to convey what one
wants to say or do (C. Goodwin, 1995, 2004, 2018), interweaving multiple modalities to
augment their communication (Savarese, 2022). Beginning a research agenda around
surfacing the multiple modalities used by non-speaking autistic individuals, if we—family
members, clinicians, educators, scholars—subverted the production of speech in daily
interaction, then what interactional practices do we center? Through integrating: (1) reflexive
video-based fieldwork; (2) microanalyses of embodied interaction; and (3) design and
development of novel tools for communication, this three-paper dissertation surfaces the
everyday embodied interactions of non/minimally-speaking autistic individuals.

The first study in this dissertation examines the everyday social interactions of two
differently-disposed actors—a non-speaking autistic child and his speaking mother—who

achieve and sustain joint attention through dialogic turn-taking during small activities at home. The study surfaces how the child is intervened upon through demands to talk by his mother. However, the child defies these demands by co-creating long sequences of interaction with his mother, in which he agentively achieves his own goals in the midst of conflicting agendas. The study highlights a longstanding tension between a traditional medically-driven approach to disability, which emphasizes individual remediation, and a call to subversion by the disability community for rights to communicative diversity.

The second study in this dissertation examines the participant roles the researcher embodies during the process of conducting video-based fieldwork involving non-speaking autistic participants, and how the actions of the researcher can have great influence over the course of the unfolding interactions being documented. Studying these roles unearths participant orientations to the camera, the complex interactional work undertaken by the researcher, and ethical dilemmas when the positionality of the researcher becomes blurred.

The third study integrates reflexive video-based fieldwork within iterative cycles of design-based research. As a critique of the bias towards referential language production in traditional AAC design and daily verbal conversation, this study designs and brings novel artifacts—floormats that map interpersonal touch to sound—into the homes of non-speaking autistic children. Instead of intervening on the child, the study intervenes on their environment in order to consistently forefront social actions—such as interactive stimming (Dickerson et al., 2007; Chen, 2016; Chen, in preparation; Sinclair, 2010)—within the repertoire of the more vulnerable communicator, allowing adult interlocutors to move beyond speech and participate in embodied interaction with the child.

Overall, this dissertation expands on empirical accounts of the communicative competencies of non/minimally-speaking autistic individuals (Chen, 2013, 2016, 2021, 2022; Dindar, 2017; Jaswal et al., 2020; Ochs et al., 2005; Prado & Bucholtz, 2021; Solomon, 2010b), and particularly, the participation of stims in social interaction (Chen, 2016, 2022; Dickerson et al., 2007). The embodied interactions of non-speaking autistic individuals are likened to the cultural practice of improvisation, where multisensory exploration and the creation of new structures is co-achieved by multiple interactants. Through combining different methodological approaches and practicing reflexivity throughout the research process, this dissertation bears implications for the design of therapeutic interventions for the communicative wellbeing of non-speaking autistic individuals. Non-speaking autistic individuals have spent too long accommodating to us. It is time we—speaking interlocutors—began listening to them.

Dedication

To my participants, with gratitude.

To Matthias[1] and Mom, with love.

To Rachel, 10 years younger, with pride.

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[1] This is a pseudonym to protect Matthias' identity.

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Acknowledgements

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1   Introduction

No person will ever comprehend,
How hard it is when I hardly feel my hands.
You won't understand
Why we sit for hours just sifting sand.
I only want to play in such a way,
to awaken my senses, it sometimes takes all day.
I need help, I need to be consoled,
Trapped in a body I cannot control.

- fifi coo[2], April 27, 2016

To be born in a world that upholds specific conventions and norms, and assumes a standardized way of being, is a challenging situation. Constraints are often placed on those who do not fit into society's systems neatly. Often, these constraints make invisible the lived experiences, meaning-making practices, and narratives of people who live different lives from what is dominant. In our speech-centric, hearing-privileged world (Savarese, 2022), the production of oral-acoustic speech and the ability to hear the speech of others are prerequisites for social participation. A few terms have been used as labels for those who find speech production overly effortful or even impossible. The terms "non-verbal" and "non-speaking" are often used to describe those who do not orally produce words and utterances that are simultaneously hearable by others, but many other terms have also been used. As Zangari et al. (1994) discuss, conversations around terminology have been ongoing since the 1980s, just after the birth of the International Society for Augmentative and Alternative Communication (ISAAC). ISAAC was an institutionalization of a field called "augmentative and alternative communication" that emerged to support individuals for whom "speech is intensely problematic". Terms such as 'nonvocal,' 'nonoral,' 'nonspeech,' and 'nonspeaking' were inaccurate, because many individuals who needed the support of AAC could talk, only that doing so was overly effortful for them, and difficult for others to understand. "Nonverbal" was another term used early on, but despite its initial appeal was not quite precise either, since it suggests a lack of ability to 'relate' to the form of words. But words can be understood and used by those who do not orally produce them, such as by way of reading and writing.

Yet, these terms share a likeness in that all draw a binary between what is and what is not. What is the contrast being drawn when these terms are used? The ability to produce hearable words and utterances is tied to a larger premise: that to participate in interaction

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[2] Fifi coo is a non-speaking autistic writer in Singapore. When he was 8 years old, fifi began communicating with his mother through pointing to letters on an alphabet board. In 2018, he published a book of his poetry, together with conversations with his mother, and anecdotes and reflections from his family members. This book is called "a tiny space". Fifi is, currently, the only non-speaking autistic writer in Singapore. However, his work is part of a growing body of writing, whether on blogs, forums, books, or in articles, that constitutes the accumulating voices of non-speaking autistic individuals.

meaningfully is to produce hearable words within the context of verbal conversation. The term "multimodal communicator" has been suggested by Autistic[3] writer DJ Savarese, who advocates for a more inclusive term to describe people like him, who participate in interaction primarily through the interweaving of multiple modalities (Savarese, 2022; Sequenzia & Grace, 2015). But fundamentally, all living beings are in constant attunement with the world they are immersed in (Merleau-Ponty, 1968; Meyer et al., 2017), drawing upon a multitude of interactional resources—gesture, nods, prosody as well as various interactional material from the actions of others, and elements of the environment (C. Goodwin, 2004, 2018)—in the construction of their own social actions.

No living organism is ever born in isolation. Instead, every living being is embedded within larger ecologies, where various ecosystems come into interaction with one another as lives become intertwined across time and space. Every socially meaningful action—even posture we hold—is responsive to interactional circumstances, the relational history of parties, and the body's ongoing adaptations to its organic needs (Streeck, 2018). Some of the first and most foundational interactions children experience with family members occur not through speech, but through an embodied choreography of hugs, shepherding, and various touch-based practices as family life is navigated (M. H. Goodwin & Cekaite, 2018). If, fundamentally, every organism is always in profound relation with a confluence of dynamically changing contexts, to be framed as incapable of relating to others is to be denied participation in daily life.

Studying the interactions and daily practices of those who do not, or minimally produce oral-acoustic speech sheds light on what a meaningful existence is. In addition, to carry the diagnostic label of "Autism" is to be clinically characterized as having a deficit in social communication (DSM-5, 2013) and to have different interactional practices than what is typical. Being framed as incapable of connecting with others meaningfully is a lonely existence of being frequently misunderstood (Coo, 2018). Although Autism has traditionally been used as a counterexample to the human ability to empathize, there has been a recent shift within scientific literature towards reframing the 'lack of social intent' associated with autism as the locus of the 'double empathy problem': "a disjuncture in reciprocity between two differently disposed social actors" (Milton, 2012: p. 884). With the growth of the Neurodiversity movement (Kapp, 2020), and the shift away from deficit-oriented perspectives around disability, the study of Autism reveals the infinite potential and neurodiversity of the human mind (Solomon, 2010a), opening doors to a holistic understanding of human cognition, communication, and perception (De Jaegher, 2013).

This dissertation steps beyond the traditional medically-driven approach to disability which emphasizes individual remediation, and responds to a call to subversion by the disability community for rights to communicative diversity. The three papers in this curated collection surface the everyday interactions of autistic individuals who do not produce oral-acoustic speech. Despite being immersed in interactions that constrain social participation to speech, non-speaking autistic individuals, like any other person, strive to connect with others while standing behind their own practices. The first study in this dissertation examines the

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[3] In this paper, I follow the preferences of the Autistic community for "identity-first language" (e.g., *Autistic people*) rather than "person-first language" (e.g., *people with Autism*) (Sinclair, 2013).

everyday social interactions of two differently-disposed actors—a non-speaking autistic child and his speaking mother—who achieve and sustain joint attention through dialogic turn-taking during activities at home. The study demonstrates the child's competency in co-creating long sequences of interaction with his mother, as well as in pursuing his own goals in the midst of conflicting agendas.

The second study in this dissertation examines the participant roles the researcher embodies during the data collection process, and how the actions of researcher can have great influence over the course of the unfolding interactions being documented. Video-based fieldwork is a useful methodological approach for studying these interactional practices, but how do we as researchers carry out work with people who are far more vulnerable than us? In examining the participant roles of the researcher, this study unearths participant orientations to the camera, the complex interactional work undertaken by researcher and the participants, and ethical dilemmas when the positionality of the researcher becomes blurred.

The third study in this dissertation integrates reflexive video-based fieldwork within iterative cycles of design-based research. As a critique of the bias towards referential language production in traditional AAC design and daily verbal conversation, this study designs and brings novel technologically mediated artifacts—floormats that map interpersonal touch to sound—into the homes of non-speaking autistic children. Instead of intervening on the child, the study intervenes on their environment in order to consistently forefront social actions—such as interactive stimming (Chen, 2016; Chen, in preparation; Dickerson et al., 2007; Sinclair, 2010)—within the repertoire of the more vulnerable communicator, allowing adult interlocutors to move beyond speech and participate in embodied interaction with the child.

Of central theoretical importance to this dissertation is the meticulous, acute examination of video data that reveals the interactional dimension of repetitive behaviors, a core diagnostic feature of Autism (DSM-5, 2013) and an important facet of Autistic culture (Conn, 2015; Sinclair, 2010; Kapp et al., 2019). The argument linking repetitive behavior—clinically defined as solitary behavior—to social interaction is not new. This argument began in research centered around echolalia (repetitive speech). Prizant (1978, 1983), as well as Prizant and Duchan (1981) were some of the first to empirically demonstrate how *immediate* echolalia can have social functions such as providing a yes-answer, functioning as a request, and may more broadly be an autistic child's attempt to maintain social interaction. McEvoy et al., (1988) also elaborated on the functions of immediate echolalia, steeped in a developmental perspective. Prizant and Rydell (1984) proceeded to examine *delayed* echoic utterances and how they participated in turn-taking, were accompanied with demonstrative gestures, and performed other communicative functions.

In the years to come, these accounts on the interactional dimensions of immediate and delayed echolalia were further elaborated upon empirically through microanalytical accounts in various contexts. Rydell and Mirenda (1991) examined linguistic constraints on echolalia in the language production of autistic individuals. Local and Wootton (1995), and later Marom et al., (2018) expanded on phonetic accounts of echolalia with interaction. Wootton (1999) investigated delayed echolalia, teasing apart echoes that are communicative, and those that are not. During the same year, Tarplee and Barrow (1999) published a paper examining delayed echoing as an interactional resource in a young autistic child's speech. Stribling et al.

(2006) detailed the placement of delayed echolalic utterances and documented how they are designed, and Stribling et al. (2007) examined the sequential organization of echoes that repeated turn-initial or turn-final lexical items from a previous turn, further nuancing accounts of immediate echolalia. Sterponi and Shankey (2014) and Sterponi et al. (2015) later joined the echolalia discussion, demonstrating how immediate and delayed echolalia respond to interactional trajectories in marking different stances.

Apart from the body of work on echolalia, other accounts of repetitive speech in Autism have been published over the years. Dobbinson et al. (1998; 2003) have discussed the interactional significance of formulas in autistic language. Other accounts of formulas have also been discussed in Sterponi and Fasulo (2010), who wrote about the repetition of appendor questions to display stance, and Muskett (2010) who argued that the inflexibility associated with an autistic child's repeated speech is actually the child's strategic attempts to retain control over the unfolding interaction. Chen (2022), the first paper of this dissertation, reveals that repetitive speech by autistic individuals can be co-produced. It demonstrates how a non-speaking autistic child and his mother co-construct interactional formulas repeated across multiple contexts, and how the child can use these to redirect parental attention.

Research on the social relevance of stimming—repetitive movement such as tapping, rocking, flicking—is relatively newer. Stimming has a long-held status as solitary behavior, and even as distracting to social interaction (Leekam et al., 2011; Lewis & Bodfish, 1998). Further, it has been empirically shown to be the object of stigma and social rejection by neurotypical peers (Ochs, 2015). The first paper to examine interactional dimensions of this phenomenon through microanalytical accounts is Dickerson et al. (2007), which studied the tapping actions of autistic students in therapy. The paper found that the tapping actions, when examined sequentially, played a significant role in interaction by displaying engagement and projecting a forthcoming response. Bakan (2014) also found repetitive motor mannerisms of Autistic students in a drum circle to be productive, communicative, pleasurable, and socially valuable.

In an extensive study spanning diverse video data from different contexts, Chen (2016) examined the interactional dimension of repetitive behaviors of non-speaking autistic individuals, showing how these movements present variation even when produced outside of interaction, change in intensity with emotional displays within social interaction, and are attuned to the movements and engagements of others. This dissertation, as well as Chen (in preparation), build upon this line of work, examining interactive stimming between non-speaking autistic individuals and others. Notable work has also been published by Shield et al. (2017), which discusses sign language echoes by autistic children who are also deaf.

The notion of "interactive stimming" used in this dissertation is adopted from the writing of autistic individuals. Jim Sinclair, in describing an encounter in which he produced stims with other autistic individuals, wrote that it is "powerful" and "amazing" to have meaningful communication through interactive stimming. He mentions the phenomenon of autistic people using fixations to connect with each other in what he calls "another form of natural autistic social behavior—interactive stimming" (Bascom, 2012, p. 25). Since then, accounts of stimming with others have been found in other autobiographies (Coo, 2018; Higashida, 2013 etc.).

Research on autistic interaction more broadly has mainly been conducted on autistic individuals who are able to speak. There is just a handful of research that detail the interactions of autistic individuals who would be classified as 'non-speaking' (Chen, 2013, 2016, 2021, 2022; Dindar et al., 2017; Jaswal et al., 2020; Ochs et al., 2005; Prado & Bucholz, 2021; Solomon, 2010b). This dissertation expands upon an understanding of autistic sociality beyond speech, and empirically builds upon research on interactionally attuned stimming (Dickerson et al., 2007; Chen, 2016) that takes as a point of departure 'interactive stimming' as defined by autistic writers.

2　Improvisations in the embodied interactions of a non-speaking autistic child and his mother: practices for creating intersubjective understanding[4]

2.1　Abstract

The human capacity for intersubjective engagement is present, even when one is limited in speaking, pointing, and coordinating gaze. This paper examines the everyday social interactions of two differently-disposed actors—a non-speaking autistic child and his speaking, neurotypical mother—who participate in shared attention through dialogic turn-taking. In the collaborative pursuit of activities, the participants coordinate across multiple turns, producing multi-turn constructions that accomplish specific goals. The paper asks two questions about these collaborative constructions: 1) What are their linguistic and discursive structures? 2) How do embodied actions contribute to these constructions? Findings show that the parent and child repeatedly co-produced multi-turn constructions that had consistent structures, implying a sophisticated ability to anticipate the completion of action trajectories. Examining the embodied actions of interactants revealed that the child often accommodated to the parent's demands for participation. Nonetheless, the child occasionally pursued his own goals by improvising with and within multi-turn constructions. He launched constructions to redirect parental attention, and otherwise produced surprising actions within the turn-taking structure of these constructions. The paper concludes that multi-turn constructions in the midst of activities are a primordial site in which to begin observing the competencies of non-speaking autistic children for intersubjective engagement.

2.2　Introduction

Social interaction is the lived context within which intersubjective meaning-making occurs. Examining the organization of social interaction has particular significance for the study of autism, which has been predominantly conceptualized as a disability of communicative deficit (DSM-5 2013) and diminished social motivation (Mundy, 2016). Studies on language and autism have focused their attention on the autistic[5] participant, and delineated autism as a condition of pragmatic impairment (Eigsti et al., 2011, Gernsbacher et al., 2016, O'Reilly et al., 2016). Ultimately, pervasive scientific accounts interpret autistic behaviors as displaying a lack of social interest, whether it be a lack of shared mutual gaze, or the production of repetitive behaviors (Jaswal & Akhtar, 2020). However, many testimonies of autistic people have contradicted these accounts, expressing the need for a sense of belonging (Mitchell et al., 2021), as well as the desire for friendship, even in childhood (Conn, 2015).

In recent years, there has been a shift within scientific literature towards reframing the 'lack of social intent' associated with autism as an issue involving experienced disjunctures between individuals of different dispositional outlooks, such as autistic and non-autistic people, as they participate in social interaction together (Milton, 2012). These interactions

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[4] This paper first appeared in *Cognitive Linguistics* 2022.
[5] This article adopts identity-first language (American Psychological Association, 2020) as a form of allyship with disability communities who have expressed preferences for empowerment via identity. See also Sinclair (2013) on the Autistic community's preference for identity-first language.

have been fore-fronted as the locus of the 'double empathy problem': "a disjuncture in reciprocity between two differently disposed social actors" (Milton, 2012: p. 884). Autistic interactants may not produce non-verbal and verbal markers of rapport—shared mutual gaze and discourse markers of attentiveness such as 'mmhm'—that may be expected by neurotypical interactants, but are less important to autistic interactants (Rifai et al., 2021). Neurotypical interactants therefore experience disjuncture when autistic interactants breach neurotypical expectations for joint attention.

The interactional asymmetry between autistic individuals and neurotypical others begins from the earliest years of an autistic person's life: autistic children are often born into neurotypical households and participate in family life with neurotypical parents. The significance of these parent-child interactions cannot be underestimated. In a first delineation of autism, Kanner (1943) presents case materials that comprise descriptive narrations from parents, expressing feelings of disconcertment, puzzlement, and discouragement at the different ways in which their children were relating to others and the world around them (Sterponi & Chen, 2019). At even greater disparity within a parent-child relationship is the minimally/non-speaking autistic child, who is limited in their ability to produce oral-acoustic speech. It is estimated that one-third of the autistic population is 'non-speaking' and do not develop oral speech beyond a few utterances (Strid et al., 2013). Yet, verbal speech is the dominant modality for social interaction, thus positioning the non-speaking autistic child in interactional contexts where speech generation is privileged over other forms of social action (Chen et al., 2020). Despite these differences, can non-speaking autistic children and their speaking neurotypical parents share in joint attention? Furthermore, can they achieve intersubjective understanding? If so, what are the implications for the non-speaking autistic child's ability to comprehend and use language?

The interactions of the non-speaking autistic child and their speaking neurotypical parents serve as a fundamental context for the study of intersubjective engagement and provide a circumstance where typical language use cannot happen. This paper closely examines the embodied interactions of a 5-year-old non-speaking autistic child and his mother in everyday life at home. How do these differently-disposed actors achieve mutual understanding, and what are the implications for unveiling the social competencies of the non-speaking autistic child?

2.3   Typical development of shared attention

Joint attention is fundamental to social interaction (D'Souza et al., 2017; Tomasello, 1995). Joint attention can occur through multiple modalities, but its accomplishment is usually attributed to coordinated gaze (Battich et al., 2020). A developing autistic child participates within interactional contexts that may have conventionalized mutual eye gaze as the valid form of sharing in joint attention, but many empirical studies have reported that autistic children are limited in sharing in joint attention through mutual gaze (Bruinsma et al., 2004; Fletcher-Watson, 2009). Autistic children have been reported to discern where others are looking but are found to tend not to orient their gaze to others (Leekam et al., 1997). Their lack of shared gaze with others is often interpreted as demonstrating a lack of joint attention, and as an early indicator of autism (Korkiakangas, 2018). However, autistic individuals experience different sensory dimensions than do non-autistic others, and have

unique modes of experiencing and relating to the world (Nolan & McBride, 2015). They have also reported that mutual eye contact within interaction is less significant for them than it is for others (Korkiakangas, 2018). Autistic children therefore may not develop the same attentional structures with their non-autistic parents as would a typically-developing child.

In the developmental trajectory of a non-autistic infant, shared attention with others fundamentally involves the mutual maintenance of face-to-face eye contact (Tomasello, 1999; Tomasello et al., 2007). Neurotypical infants produce gaze-following behavior incrementally during the first few months of age, learning to discriminate others' gaze direction by the age of 4–5 months (Caron et al., 1997; Farroni et al., 2000). By the age of 6 months, they can follow a caregiver's gaze to an object if it is in front of them (Brown, 2012). By 9–10 months, infants follow head- turns and gaze shifts of others spontaneously, even if the object being oriented to is not in their immediate visual field (Brooks & Meltzoff, 2005; Scaife & Bruner, 1975). An attunement of one's gaze to another's invites shared attention by rendering —even manifesting—one's bodily spaces visibly accessible to other interactants (Sweetser, in press; Sweetser and Stec, 2016). Gradually, typically-developing infants learn to follow the gaze of their caregiver and come to learn that their caregiver will follow their gaze in turn. Neurotypical infants and their parents jointly orient to features of the environment that are relevant to ongoing activity (Goodwin, 2003), and both can coordinate visual attention towards an object of reference (Tomasello, 1999). This triadic relation of infant – caregiver – object is a crucial milestone that has been purported to be a precursor to other important developmental milestones. The infant's joint gaze trajectory is eventually amplified by the development of pointing, a universal deictic gesture (Kita, 2003; Sweetser in press) that provides a social-cognitive, social-motivational infrastructure of shared intentionality (Tomasello et al., 2007). Declarative and imperative pointing to distal targets has been identified as intrinsically related to referential language processing (Butterworth & Morrisette, 1996). Through gesture-plus-word combinations (Iverson & Goldin-Meadow, 2005) such as demonstratives (Diessel, 2006), the infant develops spoken language (Morford & Kegl, 2000; Özçalışkan & Goldin-Meadow, 2005; Rowe et al., 2008).

Typically developing children, through shared gaze, pointing, and eventually speech, not only follow their parents' interactional projects, but also demonstrate ability in directing their parents' attention. Fine-grained analyses have shown that autistic children's shifts of gaze can be used as interactional resources (e.g., Dickerson et al., 2005; Korkiakangas and Rae 2014). Nevertheless, the reported lack of joint attention between autistic children and caregivers through limited gaze coordination and pointing, especially declarative pointing (Baron-Cohen, 1989), seems to demonstrate a disjuncture in the significance of gaze to non-autistic interactants than to autistic interactants.

Eye gaze is a precursor to more complex modes of neurotypical communication (e.g., gesture and language). Since many autistic children do not meet this developmental milestone for shared attention, research is needed on other joint attentional possibilities in their daily interactions: the development of shared attention between autistic children and their non-autistic parents may be present in yet another form.

2.4.   Dialogic resonance in autistic interaction

Newborns in early infancy already display exceptional abilities to engage in coherent, musical movements and vocalizations that are attuned to the presence of attentive others (Trevarthen, 1998, 2012). Such self-other engagements emerge as forms of intersubjective coordination as early as the first weeks of an infant's life (Hobson, 1991). Infants and their caregivers engage in joint attention, through an affective confluence of embodied actions within a highly relational shared reality (Trevarthen et al., 2011). These mutual attunements form the basis for intersubjective engagement as the child continues to develop.

Vocal turn-taking occurs in the early months of life (Bruner, 1983). The term protoconversations has been used to describe the affectionate, expressive, reciprocal exchanges between infants and their parents (Trevarthen, 1979). Neurotypical infant-parent dyads have been found to produce rhythmic alternations of vocalizations, co-creating and building upon a shared communicative musicality (Malloch & Trevarthen, 2009). These conversation-like exchanges involve both turn-taking and overlapping vocalizations, and are produced by parent and infant as early as the end of an infant's second month of life (Gratier et al., 2015). Through sound play, children reuse the phonological shape of their parents' utterances, repeating or modifying slightly a sequence of sounds (Schieffelin, 1983). The alternating vocalizations between infants and their mothers, which Bateson (1975) describes as produced "with pleasure and a sort of delighted courtesy" (p. 101) are significant in the development of conversational interaction.

Autistic children's ability to take interactional turns has been empirically documented in multiple studies. These interactional turns are not simply sound play: they have been found to be sensitive to prior syntactical structure. Du Bois et al. (2014) and Hobson et al. (2012) found that autistic child-participants were able to dialogically resonate with their non-autistic adult interviewers. Resonance in this perspective is inherently relational and occurs when co-participants "perceive affinities between utterances in their form and/or meaning" (p. 416), mutually reusing and transforming syntactic structure of prior talk in the structure of current talk (Goodwin, 2018). Dialogic linkage (Du Bois & Giora, 2014) between one utterance and the next—across speakers or within the speech of a single speaker— can arise across various discursive levels all at once or within a single utterance, resulting in a "catalytic activation of affinities across utterances" (p. 411).

Being able to dialogically resonate implies possible resonances across multiple interactional turns. The organization of taking turns (Sacks et al., 1978) is a prominent mechanism in the interactions between both autistic and non-autistic participants. Central to the occurrence of dialogic resonance is the frame grab (Du Bois et al., 2014: p. 416), which speakers employ by re-producing a portion of the prior speaker's words and structures, making only some grammatical adjustments. This selective and strategic use of prior linguistic structure has also been discussed as format-tying (Goodwin, 1990, 2018). Neurotypical children have been found to repeat the syntactic shape of a prior utterance to display stance, alignment, and disalignment with their peers (Goodwin, 1990; Köymen & Kyratzis, 2014). Neurotypical toddlers have been found to dialogically construct complement constructions in their peer interactions by selectively resonating and transforming the format of adult constructions in a way that allowed them to accomplish various social goals with their peers (Köymen & Kyratzis, 2014). An interactant's ability to resonate with prior

linguistic material suggests that the current speaker's verbal contribution thus acts upon dialogic affordances (Du Bois, 2014) from the utterance produced immediately prior. More specifically, Du Bois et al. (2014) and the larger framework of dialogic syntax suggests that syntactical, clausal, phrasal, and word-level structures from a prior verbal action directly shape future action.

The work of Du Bois et al. (2014) demonstrated that their autistic participants, like their non-autistic interactants, were similarly sensitive to the dialogic- syntactical affordances of verbal utterances produced by others: the autistic participants were able to successfully re-produce grammatical structure from the prior utterance. Autistic children's ability to produce verbal repetitions of prior syntactic structure is not surprising. A core characteristic of autism is the propensity towards producing repetitive patterns of behavior, including repetitive patterns of speech. Autistic children sometimes repeat part of a prior utterance in their own utterance, a phenomenon known as echolalia (Prizant & Duchan, 1981; Prizant & Rydell, 1984; Sterponi & Shankey, 2014; Stribling et al., 2007). Microanalytical studies of autistic children's interactions have found that a huge number of these verbal echoes were directly shaped by the prior speaker's utterance. Sterponi and Shankey (2014) showed how echoes by the autistic child directly followed correctives and directives issued by a parent interlocutor. Moreover, Stribling et al. (2007) demonstrated that the echoes were repetitions of specific lexical items in the prior speaker's utterance, and that the repeated lexical items were located at either the start or the end of the prior interactional turn. These empirical studies demonstrate that the production of echolalia is in dialogic resonance with previous utterances, resonating with both the linguistic structure of the utterance and the larger action trajectory of the interaction.

Unlike non-autistic children, Du Bois et al. (2014) posited that autistic participants adjusted their utterances to the immediate discursive structure, and not necessarily to the global topic of discourse. When the neurotypical adult interviewer asked questions, the autistic child responded by repeating part of the interviewer's verbal utterance. Although the child's utterances had linguistic affinity to the adult's utterance, Du Bois et al. (2014) explained that they had no topical relevance to the question.

Du Bois et al. (2014) and others have provided compelling evidence for the concrete competencies (Maynard and Turowetz, 2017) of autistic children in adhering to syntactical structure, as well as turn-by-turn alignment to the local order of interaction (Goffman, 1983). However, the autistic children's lack of orientation to the more global topic could be attributable to other factors. Being an autistic child and a non-autistic adult interviewer, the dyadic pairs of speakers in Du Bois et al. (2014) were of very different dispositions, creating interactional asymmetry in various ways. The autistic child interactant, being a neuro-minority and also a child, may have been expected to accommodate to and conform to the conventions of topical trajectory set forth by the neurotypical adult interactant. The interactional format of the interview also allows the interviewer to always take the first turn and have the autistic child produce a response. The interviewer thus has more agency over the agenda for the verbal exchange. Fasulo and Fiore (2007) found that the autistic child's conversational capacity was often diminished in favor of correctness of expression and specific narration style by adult therapists, resulting in expressed frustration and withdrawal. In the case of Du Bois et al. (2014), the adult interviewer could have introduced and

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maintained a topic that the child was uninterested in, whereas another topic may have been responded to differently.

Beginning a research agenda that considers how autistic children participate in turn-taking may reveal the surprising ways in which they are in fact competent interactants. The rapid exchange of turns also involves an overlap between language production and comprehension. It requires the sophisticated ability to project the end of a current speaker's turn while preparing a relevant response, so that it is produced in a timely manner (Levinson & Torreira, 2015). Fore-fronting the autistic proclivity towards repetition and the local order of interaction may thus analytically surface consistency in how they are interacting with others. The participation of autistic children in dialogic turn-taking demonstrates their ability to share in joint attentional structures with others. This study explores whether non-speaking autistic children would demonstrate similar competencies.

2.5.   The study

This study takes a usage-based approach to linguistic knowledge (Bybee, 2007; Fischer, 2015), considering the turn-taking system a pivotal organizing principle in interaction (Sacks et al. 1974). A functional and discursive approach allows for an examination of meaning-making beyond sentences and instead within larger discourse structure (Fischer, 2010, 2015). Language by this view is therefore inherently encoded within the structural position of discourse, and not within the discourse particles at the lexeme-level (Langacker, 2012). Constructions—form- meaning pairs—can therefore be said to encode meaning within dynamic discourse in-situ (Boogaart & Reuneker, 2017) through regularity and idiomaticity (Fillmore et al., 1988). What are the repeated, reliable ways in which the autistic child engages intersubjectively with others?

Beyond linguistic and symbolic competence, this study examines the practices within which the autistic child participates in social life, taking as a point of departure C. Goodwin's work examining Chil, a person with aphasia and limited language production ability (Goodwin, 2004, 2018). Through one-word utterances, prosody and a repertoire of gestures, Chil is revealed to be a competent interactant who precisely organizes his social actions in elaborate, embodied interaction with others. Chil understands what others are saying, invoking his social and material environment to display subtly differentiated stances and affect. By so-doing, Chil participates in rich social life with his family, co-creating meaningful practices.

Families are social systems of interdependent interactions where the child and others produce "routine relational practices for accomplishing activities" (Goodwin & Cekaite, 2018: p. 18). Interviews with mothers have revealed that they perceive their non-speaking autistic children's behaviors as emotionally reciprocal (Jaswal et al., 2020). These parents orient themselves to help build and sustain connection with their children, and thus it may be in these interactions that the competencies of non-speaking autistic children can best be examined.

There is a near absence of studies investigating the embodied interactions of non-speaking autistic children from the perspective of assuming communicative competency (see also Prado & Bucholtz, 2021). This study examines the embodied interactions of a non-speaking autistic child and his neurotypical speaking mother. The autistic child is fore-

fronted as an actor of agency, in mutual apprenticeship with others (Pontecorvo et al., 2001). Despite only being able to verbally produce 1–2 monosyllabic words with each utterance, the child is able to collaboratively pursue activities and accomplish joint goals with his mother. The following questions are addressed in this study:

1) What are the linguistic and discursive structures present in the child's and parent's interactions?
2) How do embodied actions contribute to these interactions?

2.6 Methodology and data
2.6.1 Participants and data

This paper draws upon video data of the daily life of a 5-year-old non-speaking child on the autism spectrum, Matt. As the primary researcher, I was present onsite with a handheld camera, filming Matt's interactions with different family members, and also Matt's time spent alone. I gained access to the data through ethical approval and permission from the university, and written consent from my participant's parents. The participants and I were Singaporean, and the language spoken within the family was English. Being a family member, I was familiar to Matt and his mother (Mom). I collected 10 h of video data of everyday life in our home over a period of 1 week, across a variety of everyday activities at home, including playtime, meals, bedtime preparations, swim time, and other spontaneous activity.

Matt received an official autism diagnosis at the age of 18 months, and began receiving various therapies from a young age. From the age of 2–5, Matt attended an early intervention school. His mother decided to pull him out of the school just a few months prior to the time of data collection, listing reasons surrounding a lack of care for Matt's learning and wellbeing. Matt had cycled through two speech therapists by the age of 5, both of whom only lasted 3 months with him. He underwent occupational therapy from the age of 3–5, and a controversial therapy called Applied Behavior Analysis (ABA) (Bottema-Beutel & Crowley, 2021; Kirkham, 2017) from the age of 2 to 5. Mom had explicitly expressed to me that she had felt the constant need to have her child practice speaking.

2.6.2 Analytical procedure

First, I examined the video corpus and identified all different instances of collaborative spontaneous activity between Matt and mom. This step excluded videos of Matt and other interlocutors, as well as videos of Matt by himself. Matt's and mom's interactions took place within the context of daily, mundane activities with clear temporal boundaries. These activities were centered around eating and drinking, and also specific task-based activities mom would initiate with him at various intervals throughout the course of the day. I made a collection of these, which totaled to 25 activities. The activities were anywhere from about 1 min (rubbing cream on Matt's back) to 30–60 min (eating lunch together), and I did not differentiate smaller activities within these larger activity boundaries. Second, within each activity, I then analyzed line-by-line the verbal dialog produced by Matt and mom. Repeated patterns of alternating turns between the dyad were identified and analyzed across the activities and within the activities. Third, I examined the embodied actions of the participants during these verbal constructions through multimodal interaction analysis.

Variations to the multi-turn constructions and deviations from action trajectories were identified and analyzed.

Video data was transcribed according to the transcript conventions proposed by Jefferson (2004), which allowed for the examination of communication within the turn-by-turn context of sequences (Atkinson et al., 1984). Multimodal tran- scription follows the style of Selting (2010), and additional screenshots and images follow C. Goodwin (2018). Central to this methodology is the "systematic investi- gation of the different kinds of semiotic resources and meaning-making practices that participants themselves attend to and treat as relevant as they build action within interaction together" (Streeck et al., 2011: 4). Through a combination of two open-source terminal-based programs, I used ImageMagick (The ImageMagick Development Team,, 2021) and FFMPEG (Tomar, 2006) to extract screenshots and anonymize them. I then edited the transcripts in an image editor as a part of the analysis.

2.7   Results
2.7.1   Multi-turn constructions

Throughout the data, Matt and mom meaningfully participate in interaction together, accomplishing a range of activities. These activities were often present in the form of various routines, such as mealtime and bedtime routines, that are also present in the family lives of typically-developing children (Goodwin & Cekaite, 2018; Sirota, 2006). A number of activities also occurred at a specific timeframe in the child's day, constituting daily routines embedded within larger 'communicative projects' (Linell, 1998). At times, unplanned, 'free' time would occur between larger activity junctures, for example, between mealtime and having to leave the house for therapy. During these chunks of time, Matt's mother drew from a readily- available repository of activities she could engage Matt in. Sets of objects such as colored shapes, large beads and string, and buttons and boxes with slots, were pre- organized in a few dedicated shelves in Matt's room. Matt's mother expressed to the researcher that she felt the need to "occupy Matt" and would therefore structure unplanned time with these smaller, readily-available activities.

The dyad accomplished multiple tasks and goals together, collaboratively producing larger trajectories of action. Central to the joint achievement of these activities was the coordination of Matt and mom across multiple verbal turns, building utterance upon utterance towards specific outcome. Patterns of dialogic turns were found to be repeated within a single activity, and also across multiple activities. In this paper, I call these patterns of turns multi-turn constructions (see also Goodwin, 2018): a collaborative verbal sequence between interlocutors that takes place over multiple turns, and that is repeated across various interactional contexts. These constructions led to specific goals or tasks, taking place over two or more interactional turns. The constructions were pervasive in the corpus, and had a high occurrence in mom's and Matt's interactions. These patterns of turns are called multi-turn constructions for two reasons. Firstly, the contingency of the sequence outcome rests upon each participant's turn-by-turn contributions across multiple turns, hence the usage of "multi-turn". Secondly, these sequences were repeatedly produced across various contexts of the child's life, suggesting that these sequences have locally conventionalized form-meaning pairings that can be conceptualized as an emergent constituent.

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Multi-turn constructions can presumably involve multiple modalities, but the current section is constrained to examining only the constructions of dialogic turns. Through two brief illustrations, this section analyzes the linguistic and discursive structures of dialogic multi-turn constructions.

The first excerpt below is taken near the start of a 1 min 7 s verbal interaction between Matt and mom. Both of them participate in an activity where they incrementally take dialogic turns towards mom's blowing of a balloon, and later, her release of the balloon so that it whizzes around the room on propellers. See Appendix A for transcription symbol conventions.

Transcript 1

```
7.    MOM      ((bends body to take balloon))
8.    MATT     ((walks towards space behind MOM))
9.             ((leaps into space behind MOM))
                  |((flaps hands excitedly))
10.            hh. >|°hhyaah hyah [hyah°]<
11.   MOM                        [O::ne] =
12.   MATT     = Two.
13.   MOM      Two:? =
14.   MATT     = Three.
15.   MOM      Three?=
16.   MATT     = Blow. (.)
17.   MOM      ((blows balloon))
```

The activity begins when mom bends down to pick up the balloon (line 7). Matt projects his possible engagement in the activity by walking toward mom (line 8). He leaps into the space behind her and excitedly flaps his hands (line 9), producing whispered vocalizations that animate the motion of his flaps (line 10). Rather than immediately blow the balloon, mom delays the action of blowing by engaging Matt in dialogical turns that incrementally build anticipation. She initiates the start of the multi-turn construction, inviting Matt's collaboration in progressing the activity together (line 11).

Mom begins the countdown sequence in line 11 with a lengthened "o::ne", to which Matt responds in line 12 with "two". Mom repeats after Matt (line 13), demonstrating receipt of his verbal utterance as an acceptable contribution to the sequence. The upward intonation in her "two?" serves to encourage Matt to continue with the next number in the countdown. Matt does indeed continue the sequence in line 14 with a "three", which is again repeated by mom in line 15, and again with upward prosody. Matt then produces the verb "blow" (line 16) as a command to mom to execute the action of blowing the balloon. Mom complies in line 17 by doing so.

Several discursive structures of the above excerpt become immediately noticeable. Matt produces his utterances promptly after mom's with no pauses in between. The latches of his turns to mom's demonstrate Matt's possible familiarity with this countdown exchange, or perhaps his fluency in efficiently reaching the sequence's intended end-goal. Matt is able to predict the end of his mother's stream of speech in the prior turn and produce a relevant verbal utterance in his turn. Each turn is brief, consisting of one-word utterances, dialogically produced by participants in rapid alternations.

Caregivers often repeat a child's utterance with questioning intonation to request clarification (Ochs & Schieffelin, 1984), and mom seems to do the same. The multi-turn construction consists of several two-turn adjacency pairs (Schegloff, 2007), within which mom produces the first pair part, and Matt the second pair part. Mom's first pair part utterances in lines 11, 13, and 15 are produced with the rising prosody of questions, making conditionally relevant only specific 'answers' from Matt. Mom also elongates the vowels of her utterances, just long enough for Matt to enter with the second pair part. She repeats after Matt, such that he is in fact the one providing the lexical items that progress the sequence.

Dialogic multi-turn constructions have an interactional structure that affords collaborative, catalytic momentum. Mom first proposes to begin the interactional sequence in line 11. Matt continues by producing the next lexical item in the sequence, therefore also committing to participation in the construction (line 12). Mom provides receipt of Matt's lexical contribution by verbally repeating after him, adding an upwards prosody and elongated vowels to encourage his continuation (line 13). Matt continues in line 14, and mom again verbally repeats after him in line 15. Finally, Matt produces the target linguistic construction in line 16, which then leads to mom's acknowledgment of the completed verbal procedure, followed by the execution of action in line 18 (see Table 1).

In the next example, mom and Matt are seated at a table, side-by-side with a corner of table surface between them. In front of Matt is an empty bowl and a sealed bag of cereal. Much like the prior example, mom withholds the eventual goal by initiating a verbal sequence that both have to jointly participate in. In this case, mom places the relevant items in front of Matt, *but delays opening the cereal bag and pouring it into Matt's bowl*.

Table 1: Organizational structure of dialogic multi-turn construction, transcript (1).

1.	Mom	Proposal to begin interactional sequence	Line 11
2.	Matt	Continuation and acceptance of interactional sequence	Line 12
3.	Mom	Receipt of prior turn and encouragement for child's continuation	Line 13
4.	Matt	Continuation of sequence	Line 14
5.	Mom	Receipt of prior turn and encouragement for child's continuation	Line 15
6.	Matt	Produces target verbal utterance (sequential to prior constructions)	Line 16
7.	Mom	Acknowledges completed procedure	Line 17
8.	Mom	*Execution of action*	Line 18

Transcript 2

```
1.  MOM       ((places a sealed bag of cereal and an empty bowl in
                front of MATT))
2.  MATT      el. (.)
3.  MOM       ((touches MATT's chin))
4.            He:↑lp?
5.  MATT      Open.
6.  MOM       O:↑pe::↓n. Oh, good asking for help Matt.
7.  MATT      ((opens cereal packet and pours into MATT's bowl))
```

Mom's placement of the sealed bag of cereal and empty bowl in front of Matt initiates the start of their mutual orientation to the activity at hand: preparing to eat breakfast. Mom does not allow Matt to begin his breakfast until he produces a verbal request for help. Not only must Matt produce the request verbally—and not by other multimodal means—but Matt must also produce the correct multi-word construction "help + me" before he is allowed to continue. In line 2, he begins the multi-turn construction by saying "el", which is his way of producing the utterance "help". In line 3, mom physically prompts Matt to continue with the verbal sequence by touching the bottom of his chin. Much like Example 1, mom then repeats after Matt, "Help?" with an upward intonation, which functions to elicit a further verbal contribution that would progress the sequence. Matt produces the acceptable verbal utterance "open" in line 5, which completes the required verbal request of "help open". Mom then repeats "open" after Matt in a sing-song voice and elongated vowels, praising him for asking for help (line 6). She then fulfills his request by opening the cereal packet and pouring it into his bowl (line 7).

Much like the previous example, mom initiates a prolonged verbal construction that then leads jointly towards a specific outcome. In this case, Matt is now allowed to eat his breakfast without first requesting for help. Even in his request, Matt is required to verbally produce the construction "help + open" (line 2 and line 5) before the action is executed. Both interlocutors engage in a turn-by-turn verbal sequence with one-word utterances, again with quick alternation between turns. Neither Matt nor mom lose a beat in their quick succession of turns until Matt has produced his final utterance and the goal is executed.

The dialogic multi-turn construction in example 2 shares the same interactional structure as the construction in example 1, except that Matt is the one to launch the construction. Matt proposes to begin the interactional sequence in line 2, and mom produces a verbal repetition in line 4 that provides receipt but also encourages Matt to continue. In line 5, Matt produces the target verbal utterance, and mom goes through the usual steps of acknowledging the completed procedure and executing the action (see Table 2).

In both examples, child and parent produce multi-turn constructions toward executable goals by the parent, whether the blowing of a balloon or the opening of a cereal packet. The organizational structure of these constructions is consistent (see Figure 1) and provides a reliable interactional format which can be routinized across various circumstances with ease. A proposal to begin the construction launches an action trajectory towards an eventual executable goal. The turns within the construction are both retrospective and prospective, having both affinity with a prior utterance and projecting the production of the next utterance.

Table 2: Organizational structure of dialogic multi-turn construction, transcript (2).

1.	Matt	Proposal to begin interactional sequence	Line 2
2.	Mom	Receipt of prior turn and encouragement for child's continuation	Line 4
3.	Matt	Produces target verbal utterance (adds to and thus completes construction produced in step 2)	Line 5
4.	Mom	Acknowledges completed procedure	Line 6
5.	Mom	*Execution of action*	Line 7
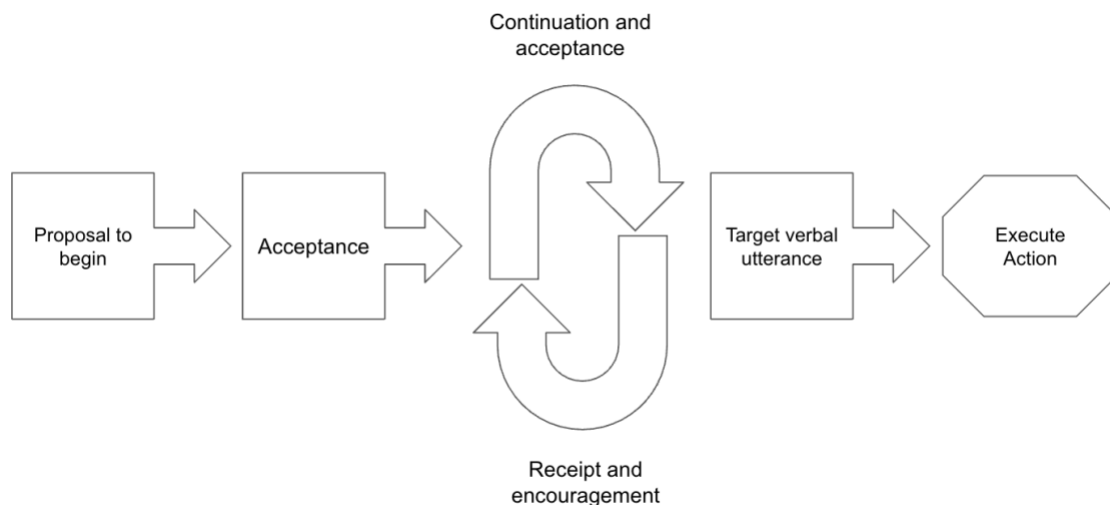
Figure 1: Organizational structure of dialogic multi-turn constructions.

Multi-turn constructions are pervasive in the corpus for three possible reasons. Firstly, the initiation of such a construction by the adult and subsequent uptake by the child necessitates the participatory commitment of both interlocutors. These routinized, collaborative constructions allow for structural coupling between utterances turn-by-turn, but also resonance relations can occur within a predictable sequence structure. Secondly, the constructions are a reliable means for intersubjective engagement where interlocutors mutually align towards the same outcome. Speakers have individual expectations of their interlocutors to complete the sequence appropriately (Clark, 2006). Lastly, the autistic children are minimally-speaking, and so are not able to produce utterances beyond just one or two syllables at a time. Multi-turn constructions spread the child's verbal output over several turns, such that each turn is simple, repeatable, and achievable. These constructions become a reliable resource for mutual understanding between parent and child.

Both examples above illustrate two different activities but share several similar core characteristics. Dialogic affinities of the multi-turn construction, namely its 1) formulaicity, 2) rigid sequentiality, 3) one-word interactional turns, and 4) quick tempo in terms of alternating utterances, all serve to propel the sequence forward with interactional efficiency. Once the instigation of the sequence by mom is responded to by Matt, both are 'locked' in a groove that churns towards a final outcome. Their joint commitment to the activity is propelled by these characteristics, which in turn aid the propulsion of the sequence. Mutual understanding in these constructions could be understood not as 'grasping' what is on another's mind, but rather, being able to 'go on' with each other (Heritage, 2007; Sterponi & Fasulo, 2010). These verbal constructions provide the security of intersubjective understanding, a joint collaboration between the adult-child dyad despite the child's limited verbal ability.

There are many possibilities behind why these constructions exist. Their internal structure of dialogic turn-taking could have developed from proto- conversations: they share the same feature of minimal gap between turns as do infant-parent interactions. Their repeated occurrence is reminiscent of formulaic language (Wray, 2009), which consists of multi-word expressions that appear to be holistically stored and retrieved, such as idioms and proverbs, commonly used by second language learners (Schmitt & Carter, 2004). These sequences are conjectured to be more easily processed and memorized when utilized within interaction (Conklin & Schmitt, 2008). Being co-produced, the constructions could have been influenced by social scripts, which are conversational routines taught to autistic children and designed for communicative usage in particular situations and activities (Loveland & Tunali, 1991; Sidtis, 2012).

The repeated use of multi-turn constructions has other implications. Verbal and lexical repetition—recycling with transformation (Goodwin, 2018)—is fundamental to early language acquisition and remains central to the architecture of intersubjectivity (Sidnell, 2014) even amongst adult interactants (Rossi, 2020). In the spirit of Hymes (1972) and Keenan (1983) discusses learning the human uses of language through repetition as the development of "communicative competence". Bybee (2002) discusses that language comprises short utterances of one, two, and more units that bind together to form longer utterances. Discourse fundamentally involves the recycling of commonly used forms (Hopper, 2011), and it is repetition that binds items into emergent constituents. The fact that these constructions repeat across multiple interactional contexts has further implications for their usefulness as units of analysis, but more importantly, their social affordances for the autistic child.

This section outlines the internal organization of dialogic multi-turn constructions, its 'binding mechanisms' of linguistic and discursive structures for coordination across multiple turns, and possibilities for accomplishing joint goals that are afforded through participating in these constructions. The child is provided with a social environment within which to meaningfully contribute to action trajectories. Despite only being able to utter one or two syllables at a time, the child can, through multiple turns, build incrementally towards joint courses of action. Matt's competency in participating in his speaking mother's communicative modality is evident, but speech is not the most comfortable modality for Matt. Although this section has examined talk-in-interaction, of equal importance is the

simultaneous organization of action (Goodwin, 2018). What embodied actions are participants producing concurrently with these multi-turn constructions?

2.7.2 Embodied actions in multi-turn constructions

The previous section discussed linguistic and discursive structures of multi-turn co-constructions. These structures work to 'bind' turns within the construction together, so that launching a multi-turn construction sparks a progression of turns towards an executable action. This section considers the embodied conduct present in the same interactions analyzed previously.

Transcript 3

```
10.              hh. >|˚hhyaah hyah [hyah::˚]<
11.   MOM                         [O::ne] =
```

```
      MATT    [˚hyah::˚]              MOM    [O::ne]=
```

3.1

((MOM turns body towards MATT.
MATT stims, facing away from MOM))

```
12.   MATT    = Two.
```

```
      MATT    = Two.
```

3.2

((MATT turns towards mom, ceasing his stim))

In line 11 of the extract above, mom begins the verbal co-construction in overlap with Matt's vocalizations and other embodied actions. As she says "one", she turns her head and torso towards Matt, reaching out with her hand. Presumably, mom faces Matt in anticipation of a face-to-face formation (Kendon, 1990). Matt, how- ever, is turned away from mom, involved in a cacophony of rapid, periodic movements incorporating all parts of his body. In

Figure 3.1, Matt can be observed excitedly flapping his forearms up and down, while synchronously moving his torso forwards and backwards with little jumps. He produces a burst of whispered vocalizations in short, quick succession, at about the same pace as his excited flaps. Matt's vocalizations themselves involve repeated movements of the tongue, jaw, and diaphragm. Matt brings his tongue to the roof of the mouth, releasing air to whisper the high front unrounded vowel [i]. He then drops his tongue and his jaw to whisper the open central unrounded vowel [a]. Each repeated vocal construction of "hyah" also involves a sharp exhalation of air from the diaphragm. Repeated vocalizations of these whispered vowel alternations occur synchronously with the fluttering motion of Matt's many bodily movements. Matt produces repeated cycles of various bodily movements in an excitatory shimmer of rhythmic fluctuations.

Through careful analysis of the movements of Matt, it is possible to observe that he accommodates his behavior to mom's participatory demands. Matt's bodily repetitions can be interpreted as stimming, one of the core characteristics of autism. The stims of autistic individuals are often interpreted by non-autistic others as displaying a lack of social interest (Jaswal & Akhshar, 2019). However, a growing body of autistic testimonials, supported by scientific research, suggests that repetitive behavior is adaptive, self-regulatory, pleasurable, and can even be interpersonal (Conn, 2015; Kapp et al., 2019; Sinclair, 2010). In this interaction, however, Matt ceases his stims to engage in dialogic turn-taking with mom (see also Chen, 2016; p. 79). Examining Matt's regulation of and gradual ceasing of his stimming is a reminder of the interactional asymmetry between him and his mother.

Mom's expectation for Matt to participate in spoken dialogue can also be observed in her bodily conduct just before Matt begins the multi-turn construction towards the opening of his cereal packet.

Transcript 4

```
2.   MATT        el. (.)
```



```
                                                  4.1
```

((touches cereal packet))

```
3.    MOM
```
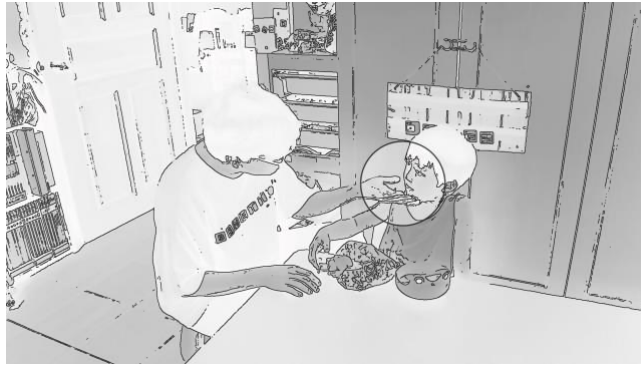


```
                                                    4.2
      ((touches MATT's chin))
4.              He:↑lp?
5.    MATT      Open.
```

At the start of the above excerpt, mom and Matt are seated at a table. Mom has laid out Matt's breakfast bowl and cereal on the table surface between them. She waits for Matt to request for help to open the cereal packet. In figure 4.1, Matt can be seen reaching out and touching the cereal packet with his right hand while producing the verbal utterance ("el") that launches the forthcoming multi-turn construction. Mom makes clear her expectation for him to not just produce verbal speech in his next turn, but to also orient his head towards hers.

Adults often use haptic directives to shape their children's bodily positions in accordance with culturally expected means of demonstrating attentiveness, which often involve face-to-face interaction (Cekaite, 2015). Mom's use of control touch (Cekaite, 2016) reveals her expectations for Matt to display attention in specific ways. In figure 4.2, mom's left hand is extended, palm up, and placed under Matt's chin, lifting his face toward hers. Mom can be observed to stoop her head in orientation to Matt's. In addition, by touching Matt's chin, mom brings into Matt's awareness his mouth, prompting his speech in the following turn. Mom's gesture halts the progressivity of the multi-turn construction, making known to him her requirement for its continuation. Matt has to look at mom *and* produce the correct verbal utterance before the sequence can progress. Thus, the progressivity of the sequence is contingent upon the production of specific embodied actions that are deemed by mom as demonstrating shared attention. Constraints are placed upon Matt's behavior as he accommodates to mom's participatory demands for neurotypical joint attention.

Mom is the gatekeeper for sequence progressivity and eventually, for the execution of action on the last turn of multi-turn constructions. As revealed in this section, although Matt competently participates in dialogic turn-taking with mom, he does so by constraining his bodily movements and orientations in ways that are expected of him by mom. The overall activity agenda is also one that is structured by mom, prioritizing her agency over the trajectory of action of a multi-turn construction. Despite these interactional circumstances, can Matt exercise agency in determining collaborative courses of action?

2.7.3   Multi-turn constructions as resources for improvised action

The action trajectories that parents launch can place strong constraints on their children's future action. For example, parents often use directives—actions employed for getting people to act (Goodwin, 2006)—to get their neurotypical children to accomplish

various tasks and activities (Goodwin, 2006; Goodwin & Cekaite, 2018). Despite these strong participatory pulls into compliance, autistic children, like neurotypical children, have been shown to display forms of resisting, distracting, and negotiating. Henderson (2020) examined how a speaking autistic child negotiated the establishment of extended directive trajectories (see also "activity contracts", Aronsson & Cekaite, 2011). The child asserted his own autonomy by rejecting his mother's directives and negotiating her requirements to perform certain tasks.

Speaking autistic children's capacity to direct the course of an adult's action has also been found to occur through forms of repeated words, phrases, and questions. For example, the production of echolalic utterances within larger action trajectories has been found to afford the disruption of ongoing courses of directive action (Sterponi & Shankey, 2014). Sterponi and Fasulo (2010) analyzed a child's repeated use of appendor and tag questions such as "or else?" to create a future interactional slot, engaging in repetitive word play with their parent as a means to expand upon the interaction. Within a speech therapy setting, Muskett et al. (2010) examined the interactions of an autistic child, who repeatedly used the question "do you know what?" to project a topic initiation in later turns. The paper proposed that the autistic child's 'inflexibility' was but a product of his strategic attempts to regain control over an unfolding interaction. For the non-speaking autistic child, Matt, and mom, multi-turn constructions are reliable resources for the mutual accomplishment of goals. What might Matt do if he does not share the same goal as mom?

An interplay between repeated, routinized ways of interacting and locally contingent improvisations could be said to exist in discourse (Günthner, 2011). Goodwin (2018) and Hopper (2011) describe grammar at the conversational level as the result of improvising publicly and jointly new combinations of forms. The improviser, at heightened attention and awareness, draws upon material from before into new situations of intersubjective attention (Breyer et al., 2011). The act of improvising is one of "surprise and anticipated order" (p. 190) with increased sensibility of temporal alignment (Breyer et al., 2011).

Creating new situations of intersubjective attention can place stress on the security of intersubjective understanding, where risk is involved in the strain be- tween mutual understanding and sequence progressivity (Sterponi & Fasulo, 2010). This section examines interactions where the dyad is misaligned in goals. The child transforms the action trajectory of joint interactions between him and mom in two different ways, risking a breakdown of intersubjective understanding, but counting on the mutual intersubjective grounds of multi-turn constructions in order to progress their interactions.

2.7.3.1 Redirecting attention by launching multi-turn constructions

In the previous sections, it has been established that once a multi-turn construction begins and is continued by the child, participatory commitment to progress the interaction to its end is required from both interlocutors. Extricating oneself from such a sequence is therefore difficult once a construction is set in motion. This section examines Matt's launching of a multi-turn construction to redirect mom's attention, a use case that occurred four times in the data corpus.

In the following example, Matt and mom are seated side-by-side in the middle of the room. Matt is drinking juice using a straw that is placed in a cup. Mom is holding the cup for

him for most of their interaction, but it becomes clear that she wants him to hold his own cup. Matt instead continues to hold the straw with both hands, twiddling with it. Each time mom takes his hand and puts it on the cup handle, Matt loosens his grasp such that the main weight of the cup still rests on mom. Much like the use of repeated directives to reduce noncompliance that have been reported elsewhere (Henderson, 2020), mom issues the directive "hold the cup" repeatedly, but to no avail. Eventually, mom takes the straw out from the cup, and Matt is forced to hold his own cup.

Transcript 5

1. MATT

5.1   5.2

((MATT gazes in direction of cup, then in the direction of the straw))

2.

5.3

((MATT gazes up and reaches for straw))

3. MOM   **Why?**
4. MATT

5.4

```
                    ((MATT gazes in direction of straw and speaks))
                    Straw=
 5.   MOM          =you want the straw?=
 6.   MATT         =plee-ee.=
 7.   MOM          =°okay°
 8.                ((MOM returns straw to the cup))
 9.   MATT         ((MATT takes the straw with his hands))
10.  MOM
```


5.5

((MOM holds cup))

In the example above, Matt is holding his own cup in line 1. In Figure 5.1, mom's left hand can be observed just leaving the bottom of Matt's cup. She holds Matt's straw, which she has just removed from Matt's cup, in her right hand. Matt gazes in the direction of his cup. Matt brings his face over his cup in Figure 5.2, as if taking a sip. His eyes shift towards his left, and in the direction of the straw. Mom removes her hand from the bottom of the cup, finally succeeding in having Matt hold his own cup. In line 2, Figure 5.3, Matt gazes away from the straw, looking up, but reaches his left hand out towards the object. The simultaneity of Matt's shift in gaze and his hand movement is striking. Matt looks upwards, almost as if he was disattending to the straw. Mom identifies Matt's reach for the straw as a trouble source: she re- quires a proper verbal request. The occasion therefore calls for the instigation of a repair in the next turn (line 3), in which mom issues the open class repair 'why?' (Drew, 1997), seeking clarification as to what Matt was trying to accomplish. Matt immediately initiates the familiar multi-turn construction of a request in line 4. He says "straw" and can also be observed to once again shift his gaze, this time, in the direction of the straw (Figure 5.4). Mom responds with "you want the straw?" in line 5, jointly committing to the sequence, and thus, committing to completing the multi-turn construction. Both become aligned in the common goal of returning the straw to Matt. Mom's question in line 5 also serves to prompt Matt to continue with the sequence and provide the rest of the verbal construction to his request. Matt responds in line 10 with the deferential marker "please", articulated as "plee-ee" by Matt. Matt therefore provides the second target word in this sequence, to which mom responds by confirming the completion of the verbal sequence (line 7), fol- lowed by the execution of the goal (line 8). By engaging in the construction, mom is directed towards progressing an action trajectory that Matt launches, and jointly committed toward fulfilling the goal of giving Matt his straw back.

Once launched, the first turn of the multi-turn construction catalyzes an affinity of turns between Matt and mom, diverging the interaction towards an alternative goal. Matt,

having taken the first turn of the multi-turn construction, dislodges mom from her focus of attention, establishing a new, shared orientation towards a different communicative project. The binding features within the multi-turn construction that afford progressivity and intersubjectivity allow the child to redirect parental attention toward enacting a different goal. Matt even assists in the establishment of the multi-turn construction through gaze aversion (Korkiakangas & Rae, 2014) and other deliberate shifts in his gaze (Dindar et al., 2017). Matt can, if he takes the first turn, launch multi-turn constructions that project trajectories of action, even if these actions differ from the directive trajectory that mom projects. But what happens when Matt cannot take the first interactional turn?

2.7.3.2. Alternative actions within multi-turn constructions

This section examines how Matt produces alternative actions within the turn- taking structure of the multi-turn construction. Across the multi-turn constructions, alternative actions were substituted into their internal dialogic structure in at least one turn around 40% of the time. In example 6, Matt has a four-tiered ramp in front of him, and mom has a few toy cars in her hand. During each round of play, mom presents two cars to Matt and asks him to choose one. Matt then takes one of the cars from mom and is expected to place it at the top of the ramps. Matt and mom then collaboratively produce a "ready... set... go!" sequence, at the end of which Matt releases the car. In this particular extract, which was taken from a longer 4 min sequence, mom presents Matt with the 'last car', signaling the end of their activity.
Transcript 6

```
1.  MOM      orh::. Last car! Okay last car?=
2.  MATT     =oyar.
3.           ((raises hand to put car on structure))
4.  MOM
```

```
             ((uses hand to block car))
5.           Ready?=
6.  MATT     =le-go.
7.  MOM      SEt.
8.  MATT     Go.
9.  MOM      °go.°=
```

```
10. MATT
```



```
                    =|                                    6.2
                    ((makes the car go up and down the curve without
                    releasing it))
11.                 =|° eeee yah:::: ee[ee yah]::::::: lahhhh eee
                    yah::.°
12. MOM                             [|go::↑]!
13.                                 |((puts hand on ramp))
```

Mom first tells Matt (line 1) that he would be releasing the 'last car', thus projecting the impending end of their activity. Matt responds in line 2 by repeating "last car". Because he cannot pronounce sounds such as [l] as in the word "last", and [k] in the word "car", his utterance is produced as "oyar". Matt repeats mom's "last car" in his own turn. Matt and mom then go through the usual procedure; in line 3, Matt raises his hand and puts the car on the ramp structure. In line 4, Figure 6.1, mom uses her hand to block Matt from releasing the car too early, since he is only allowed to release the car after they have completed the multi-turn construction together.

In line 5, mom begins the multi-turn construction with Matt. Within this activity, the dyad had produced this particular multi-turn construction several times before this particular instance. By continuing with the sequence in line 6, Matt has agreed to proceed with the sequence yet again, establishing participatory commitment to the activity. Matt's response, "let-go", in fact jumps the sequence ahead in providing the command to let go of the car. Mom, however, conforms to the structure of the sequence by continuing with "set" in line 7. Mom therefore upholds the structure of the multi-turn construction "ready... set... go" despite Matt's bid to jump the sequence ahead. Matt says "go" in line 8, adjusting his utterance to respond to mom's prior utterance. Mom confirms Matt's correct use of "go" by repeating after him in line 9.

At the end of this exchange, Matt makes an unusual move: instead of releasing the car, he runs it along the contour of the slope (line 10), accompanied by elongated vowels "eee-ah" (line 11). He interacts with the car in a way different from how mom had run the activity, feeling the sensation of the car below his finger as it runs along the curve of the ramp. Matt animates the movement of the car: as it glides up and down the slope, his vocalizations are synchronized with the motion of his hand. Matt had followed through with the verbal format to its end, and yet, precisely within the interactional slot in which Matt was to execute the releasing action, he enacts his own move. Matt therefore produces his action as sequentially progressing from the sequence's final move, as if it were part of the sequence. In

the process of substituting the action of releasing the car with the action of running it up and down the slope, Matt prolongs the interaction so as to delay the release of his toy car.

Mom and Matt are clearly misaligned in the activity at hand. Mom in line 18 repeats her command "go" with an exaggerated upward prosody, urging Matt to release the car from his hand. Mom simultaneously places her hand in the middle of the ramp (line 13) so as to block Matt's action of running the car up and down. Mom has instead designed the activity as one that involves releasing the car and watching it slide down the ramps. As the interaction continues, mom attempts to steer the interaction back to her project.

Transcript 7

7.1

((MATT takes his hand with car and puts it on bottom of structure))
((MOM attempts to hold MATT's hand))
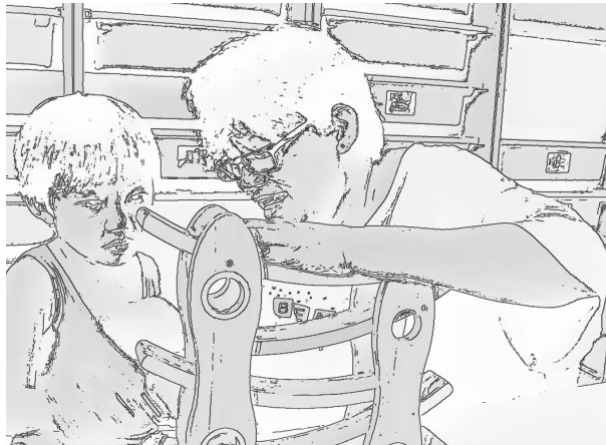
7.2

((MOM reaches down and hold MATT's hand))
((MATT purses lips and stares intensely at ramp))

```
1.  MATT
    MOM

2.  MOM/
    MATT

3.  MOM       |ready::::=
4.            |((takes Matt's hand with car and puts it on top
              of structure))
5.  MATT      =mm.=
6.  MOM       ((blocks slope with hand))
7.  MOM       =se::|:t=
```

```
8.
```



```
                       |                                    7.3
            ((leans body back, prematurely lets go of car))
9.  MATT      =|go.
10.            |((bows head and looks away))
```

In line 14, Figure 7.1, Matt takes the car and places it at the bottom of the structure, escaping mom's hand at the top of the structure. Mom is swift and reaches down to hold Matt's hand in line 15, Figure 7.2. Matt can be observed staring intensely at the ramp and pursing his lips. Mom then restarts the multi-turn construction in line 16, uttering "ready", with an elongated vowel on the second syllable, in anticipation for Matt's participation in this new multi-turn construction. Simultaneous with mom's restarting of the sequence, she takes Matt's hand, which is grasping the car, and puts it at the top of the ramp structure in preparation for him to release the car in the way she expects (line 17). In line 18, Matt adheres to the temporal structure of the construction by verbally stating "mm" where he is required to provide a response, as if to progress the sequence without a full verbal contribution. His diminished response and minimal participation in the verbal sequence could be interpreted as an act of defiance at being unable to progress the activity of his liking.

Mom blocks the slope with her hand in line 19 to prevent premature releasing of the car before the procedure is over. In line 20, she continues with the next utterance in the sequence by vocalizing "set", elongating the vowel in "set" in anticipation of Matt's vocalization. Midway through her vowel elongation, and in the midst of this multi-turn construction, Matt prematurely lets go of the car (line 21), another act of defiance, but mom's hand is there to block its travel down the slope. Matt's early release of the car is in noncompliance to the routine set out by mom; he is only supposed to release the car after completing the verbal sequence and when mom has removed the obstacle—her hand—that blocks the slope. Despite being unable to participate in the release of the car, Matt provides the final command in line 22, then bows his head, turning his attention away from the ramp. He progresses the multi-turn construction while disattending to the activity at hand, ending off by shifting his head and gaze away from the structure precisely when the car should be released. His minimal verbal participation in progressing the construction and deliberate non-participation in complying with mom's activity are clear displays of stance, but are not interpreted by mom as such. Instead, mom brings Matt's hand to the top of the ramp, restarting the multi-turn construction one more time.

Matt is able to delay the activity through prolonging the constructions in multiple ways. Matt takes each of his turns with temporal precision, allowing the sequence to progress. However, he changes the content of his turns, whether in enacting a different action (line 10), shifting his eye gaze (line 23), or substituting verbal contributions with a mumble (line 18). In these examples, joint multi-turn constructions open possibilities for mom and Matt. For mom, multi-turn constructions are a reliable resource for the joint accomplishment of tasks. She thus makes attempts to relaunch the construction each time Matt does not comply with her activity. For Matt, these dialogic routines are temporally predictable, thus lending a structure within which he can exercise creativity. Matt builds his action by performing transformative operations on repeated, intertwined interactions between him and mom (Goodwin, 2018). He progresses the dialogic construction, yet, within its boundaries, gains extra time with his car and prolongs the activity. Matt's moves are timed to progress verbal dialog, yet he is able to carve pockets of time within the turn-taking system to pursue activities of his pleasure and enjoyment. By minimally contributing to the construction, and releasing the car prematurely, Matt can demonstrate stance through his bodily comportment while verbally progressing the construction.

2.8   Conclusion

Can two differently-disposed actors—a non-speaking autistic child and his speaking neurotypical mother—come into intersubjective understanding? The analyses in this paper demonstrate Matt's sophisticated interactional competencies despite being limited in speaking, coordinating gaze, and pointing. In fact, Matt was able to speak, produce gaze shifts meaningfully, and jointly orient to object references within the structure of multi-turn constructions, embedded within activities. Intersubjective understanding emerges from locally co-produced action, where a history of routine, reliable means of achieving intersubjectivity affords fluency and constituent structure (Bybee, 2007; Goodwin, 2018). Much like Home Signs that emerge locally in social contexts with deaf children (Goldin-Meadow et al., 1984; Williams, 2004), multi-turn constructions could be viewed as 'home constructions' that emerge and become conventionalized within their own local contexts. It is worth noting that these constructions emerged from asymmetries between Matt and mom: the roles of child and mother, the interactional asymmetries of child and adult, as well as asymmetries based on their different neurodiverse constitutions. Nonetheless, Matt demonstrates competency at navigating asymmetry. As an actor of agency, Matt can be likened to that of an improviser, using past elements in a novel fashion, and creating new contexts of intersubjective attention (Breyer et al., 2011). Just like Chil (Goodwin, 2004), Matt is able to co-operatively invoke structures within his social and material environment to construct meaningful practices with others. With sensitivity to temporal alignment, Matt participates in producing language at the conversational level, constantly orienting to, and even at times diverting mom's attention. He has a good understanding of where mom would tend to orient and thus, he is able to produce timely, surprising actions that serve his own goals.

The socio-cognitive model of neurotypical joint attention suggests an onto- genetic trajectory of dyadic (person-person) to triadic (person-person-object) joint attention (Tomasello, 1999). Dyadic engagement is usually attributed to reciprocal turn-taking, and

eventually leads to the emergence of visual orientation to a joint object of reference, a hallmark of triadic engagement. In the development of Matt, mutual orientation towards target objects seems to occur saliently through the turn-taking system. Furthermore, these target objects are meaningful to Matt and mom over the course of multiple turns, embedded within a larger context of accomplishing activities. Multiple empirical studies have now demonstrated the ability of autistic children to project trajectories of action, revealing their sophisticated skills in anticipating, and producing temporally sensitive, complex social actions. Only through considering the multiple modalities through which attention can occur (see also Lourdes, in press), and including longer temporal trajectories in analysis, would the competencies of autistic children become observable. As researchers, what more would we learn about the socio-cognitive competencies of autistic children if we began to attend to their attentional structures and expressive modalities? Autistic individuals have reported experiencing belonging and relatedness through including others in their rich sensory lives (Conn, 2015). As a significant example, autistic autobiographers have coined the term interactive stimming—producing rhythmic behaviors together with others—that they describe as an empathetic experience of belonging and relatedness (Sinclair, 2005). What might have happened if mom had co-explored stimming with Matt, or thought to join him in playing with the car in his way? Understanding the socio-cognitive abilities of the non-speaking autistic child improviser requires attention to their actions within a local ecology of partners, materiality, and meaning-making practices, as they produce resonances, repetitions, and innovations with the world.

Appendix 1

Notational conventions employed in the transcriptions are adapted from Jefferson (2004).

.	Period indicates a falling intonation contour
?	Question mark indicates rising intonation
:::	Colons indicate stretching of the preceding sound, proportional to the number of colons
↑↓	Upward and downward pointing arrows indicate marked rising and falling shifts in intonation
>	Right facing arrow indicates lines in the transcript where the phenomenon of interest occurs
-	A hyphen after a word or part of a word indicates a cut-off
=	Equal sign indicates no break or delay between the words thereby connected
(( ))	Italicized double parentheses enclose descriptions of multimodal conduct
( )	Empty parentheses indicate that something is being said, but the speech cannot be discerned
(1.2)	Numbers in parentheses indicate silence in seconds
(.)	A dot in parentheses indicates a micropause
º butº	Words between degree symbols are uttered very softly

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My lovely friend in school is twelve.
We have only our teacher and each other,
no one else who will really bother.
It's just nice to have someone and not be by myself.
We go for walks, we hold hands and run,
what can sometimes be boring is now a lot more fun.
Now I laugh and have reason to smile,
I feel connected to myself and to him if only for a while.
I really hope that I too am a friend to him.

What do friends with autism do together every day?
I yell, I tap, he makes sounds, we stim.
In the nonverbal world of autism, this is how we play.
- fifi coo, 25 August 2016

3 The researcher's participant roles in ethical data collection of Autistic interaction[6]

3.1 Abstract

The method of participant-observation is fundamental to ethnomethodological, ethnographic video-based fieldwork. Collecting data of the embodied interactions of non-speaking Autistic individuals surfaces questions that are central to the nature of video-based fieldwork: What are the technical and interactional challenges of navigating the researcher's multiple participant roles during data collection? What are ethical issues that arise with emergent participant roles during data collection? Grounded in two contrasting pieces of data—one of two siblings in a display of intimacy, and another of a student displaying distress—this paper examines the multiple participant roles the EMCA researcher navigates moment-by-moment during the data collection process. Studying these roles unearths participant orientations to the camera, the complex interactional work undertaken by the researcher, and ethical dilemmas when the positionality of the researcher becomes blurred.

3.2 Introduction

Video ethnography is a powerful tool for the study of the everyday, situated human interactions of individuals with communicative differences. Over the last 30 years, ethnomethodology and conversation analysis (EMCA) methodologies have been used to document, precisely analyze, and thus clarify the nuanced social practices of individuals diagnosed with various communicative, cognitive (Antaki & Wilkinson, 2013; Wilkinson, 2019), and physical (Auer & Hörmeyer, 2017) disabilities. Recording and analyzing naturally-occurring interaction has been especially beneficial for the study of individuals with little to no speech production capacity. In the notable empirical and theoretical work of Charles Goodwin, Chil, a person with Aphasia and limited linguistic production, is revealed to position himself as a competent interactant through elaborate, temporally-coordinated collaboration with others (C. Goodwin 2004). By shifting the analytical focus from speech to the organization of situated action, Goodwin's work uncovers the cognitive life of Chil, and elaborates upon Goffman's model of participation frameworks (Goffman, 1981) beyond the traditional model of talk. Goodwin and Goodwin (2004) posit that privileging the stream of speech as an analytical focus for participation in interaction concomitantly denies full status of a participant who lacks fluent, complex speech ability.

By providing evidence and accurate grounds for observable social phenomena (Garfinkel, 1967; Sacks, 1992), EMCA methodologies can make 'taken-for-granted' knowledge explicit by transforming tacit resources into topics that are elucidated in their own right (Watson, 2006). For the study of non-speaking populations, such as the non-speaking Autistic population, the analysis of video data has much potential to surface facets of embodied interactional practices that may otherwise be missed, and to expand upon the rich accounts of autistic sociality already existing in EMCA literature (e.g. Dickerson et al., 2007; Muskett et al., 2010; Sterponi & Shankey, 2015).

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During data collection, the researcher plays a significant role in shaping an Autistic individual's conduct, especially when the researcher enters a field site with a "roving camera" (Heath et al., 2007, p. 38) and becomes a part of the ongoing social and material ecology. In the situated activity of video recording interactions, the researcher can be argued to be in a participation framework with their participants as a bystander, and sometimes, even as a ratified participant in the interaction. Technical decisions with the camera, interactions with participants on the site, and the orientation of the researcher's body to that of the ongoing scene can all have consequences for the interactions that unfold. Although promising, the process of collecting video data of non-speaking Autistic individuals brings unique challenges. Firstly, Autistic individuals experience deep permeability with their environment (Conn, 2015, Sterponi & Chen, 2019). Data collection requires careful navigation of a constantly evolving social and material environment. Secondly, Autistic individuals can experience stigma for their bodily actions and are aware of their social rejection by others (Fein, 2018; Ochs, 2015). The researcher's actions during the data collection process can amplify their felt difference from others. Lastly, they are a vulnerable population (Jaarsma & Welin, 2012), which requires that the researcher exercises sensitivity during the data collection process and after.

The technical work of data collection with non-speaking Autistic individuals has to be skillfully intertwined with careful navigation of emergent interactional circumstances. Furthermore, the researcher's involvement in participation frameworks during the data collection process can engender unexpected participant roles. The quick and careful navigation of multiple participant roles can be complicated when non-researcher participant roles are invoked by the ongoing circumstances. Because autistic subjects are vulnerable, the navigation of a researcher's participant roles onsite can even be ethically blurred and contradictory, especially when these roles are summoned by participants within the ongoing scene.

Video data collection of Autistic interaction surfaces questions that are central to video-based fieldwork: What are the technical and interactional challenges of navigating multiple participant roles of the researcher during data collection? What are ethical issues that arise with emergent participant roles during data collection? This paper examines the interplay of participant roles in collecting interactional video data of non-speaking Autistic individuals. In the first analysis, I examine two siblings in an intimate multisensorial interaction. I focus on the complexity of handling a video camera while navigating simultaneously-occurring participant roles, empirically demonstrating the Autistic child's awareness of the larger participation frameworks at play. The second analysis builds upon the first by examining the ethical dimensions of engaging in these complex interactional dynamics within data collection, as well as the ethical implications of the Autistic individual's awareness of the researcher's participation frameworks. I examine a tense interaction between an Autistic adult and his teacher. Both participants are misaligned in their agendas which leads to an accumulation of mutual tension between them. I unearth possible participant orientations to the camera and discuss implications for video recording such difficult and unanticipated situations. Lastly, I show how the summoning of the researcher's involvement in the ongoing scene puts the researcher in blurred and contradictory positionalities. I argue that in developing the professional vision of the EMCA scholar (Katila

& Raudaskoski, 2020) during data collection, the creation of participation frameworks moment-by-moment is ethical in nature.

3.3   Methods, Data and Settings

In this paper, I am the primary researcher and author for data and analysis. The social interactions examined in this paper come from two different video-ethnography corpora that I collected in Singapore. The researcher (me), and the participants were all native Singaporeans. The languages spoken onsite were English and Singapore Colloquial English (Leimgruber, 2013). As the primary researcher, I gained access through ethical approval and permission from the university, written consent from my participants' guardians, and additionally, from the Autism institution where necessary.

The first 4h corpus documents Alex, a 10-year-old, non-speaking boy diagnosed with autism, and his interactions with his parents and sister (14-year old) as they engaged in different activities at home. The family is English-speaking and Singaporean-Chinese. At the time of data collection, it was my second time visiting the family in the context of data collection. Prior to this visit, I had known them for about two years because the mother of Alex and Bridget, Aunty, was my own mother's friend. I select video data of a 30s interaction between Alex and his sister Bridget, where they sit on the floor beside me and participate in a multisensorial interaction with their hands, bodies, and feet.

The second corpus documents social interactions that transpire over a period of two weeks in an Autism institution. This facility enrolls youth and adults diagnosed with moderate to severe autism between the ages 19-55 and offers various skills training and activities for the students for about six hours a day, Monday through Friday. Data (30h) were gathered from two classes of twelve non-speaking students between the ages 20 and 30 engaging in activities such as taking walks, going for outings, gardening, crafting, and swimming. The analysis centers on an episode in which a participant displays what seems to be observable as distress behavior.
Video data was transcribed according to the transcript conventions by Jefferson (2004). Multimodal transcription follows the style of Selting (2010) and additional screenshots and images follow C. Goodwin (2018). During data analysis, I include myself—the researcher— as a co-participant in the ongoing interactions. However, as I transcribe and analyze the data, I draw upon my recollection of being present at the site, ethnographic data on my participants' backgrounds, and literature on Autism, which allow me to attend to myself as a participant within the events that unfold.

3.4   Researcher participant roles and participant orientations

This section begins from the notion that the participant-observer's and participants' reflexive orientation toward each other constitute a participation framework. Participants, including the researcher, produce courses of actions which position themselves to perceive in ways that are relevant to the activities in progress (C. Goodwin, 2007). In this section, I focus on a 30s interactional sequence that focuses on Alex in interaction with his sister, Bridget. I examine the interactional work undertaken by me partaking in simultaneously-occurring participation frameworks, and how my ongoing participation has an effect on the technical work of the camera. I then examine the Autistic child's orientation to my participation

frameworks and discuss implications for unearthing the communicative competencies of Autistic individuals.

I had been video recording for about an hour prior to this data extract, and the recording was taken during the first of two days filming the family. I had paused filming because my video camera had a low battery signal. Aunty, who inquired on my camera status, began the activity of searching for extra batteries for me. As we engaged in conversation, Bridget and Alex were seated on the floor by my right, and Bridget started to inch towards Alex. I noticed her movement and anticipated the potential forthcoming of an interaction between the siblings. I therefore turned on the camera in my hand and began the data collection process.

Throughout most of the filming of this data, I recall being physically positioned to face Aunty while simultaneously holding the camera by my side towards Bridget and Alex (Figure 1). My bodily configuration thus afforded me the opportunity to become a participant in two simultaneously occurring participation frameworks (C. Goodwin and Goodwin, 2004; M.H. Goodwin, 2006; C. Goodwin, 2007): the activity of attuning to Bridget and Alex, and the other, the activity of conversing with their mother, Aunty.

Figure 1[7]

At the start of the recording, I spend some time adjusting the camera to Bridget's and Alex's interaction while simultaneously conversing with Aunty. In the following extract, I focus on an audio-recording of my conversation with Aunty, as well as the shifting camera angles from which Bridget and Alex were filmed. I demonstrate how the interactional work I undertake has an effect on my technical work with the camera. Screenshots from the video are converted to line drawings and edited to visually demonstrate the participants' positions within the frames.

---

[7] Artwork by Kevin Di Pasupil

Extract 2

```
1       AUNTY          |Nothing leh::.
```
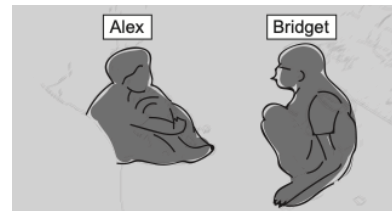

```
                       |
                        Figure 2.1
```

```
2       RACH           It's o|kay lah. (.)
```


```
                        Figure 2.2
```

```
3                      Thank you so much Aunty=
4       AUNTY          = uh h|hhh. [Hh.
```


```
                        Figure 2.3
```

```
5       RACH                   [Hhhhh. |Hhhhhh.
```


```
                        Figure 2.4
```

Extract 2 begins when the camera is turned on. Aunty uses *Singlish,* a colloquial variety of Singapore English (Wee, 2014; Wong, 2014) that is an unmarked code for informal interaction, expressing familiarity and solidarity between interlocutors (Goddard, 1994). Singlish is rich with pragmatic particles such as *ah, leh* and *lah* (Wong, 2014) which are used to convey certain attitudes or assumptions about the reactions of others (Gupta, 1994). In Line 1, Aunty's utterance "nothing leh", is an announcement that there were no batteries in the closet, with the discourse marker "leh" (Botha, 2019) indicating an apology and that she had tried her best. Aunty's use "leh" is a marker for informal interaction, and I reciprocate in a similar manner. I respond to Aunty in Singlish, stating "it's okay lah" (Line 2). "It's okay" lets Aunty know that I would not require a battery, and "lah" discourse particle indicates reassurance (Wee, 2004). In engaging with Aunty, I keep the interaction friendly, using the appropriate kinship term "Aunty" so as to sustain our participation framework.

The interactional work I undertake is coupled with technical challenges in camera placement. The video camera has a 3-inch digital screen that allows me to view what the camera is capturing. At the start of the recording, I hold the camera close to my face to look at the digital screen, thus capturing the interaction from a slight top-down perspective. As I produce my verbal utterance in Line 2, the video camera veers to the far right as seen in screenshot 2. Alex falls off the frame, and the camera shot is slanted. I continue to engage in conversation with Aunty and proceed to express my gratitude to her (Line 3). My video camera remains slanted to the right and I recall noticing the slant through quick glances at the digital screen. It is only in Line 4, when Aunty produces her turn, that I am able to adjust the focus of the video camera and include both Alex and Bridget in the shot frame (screenshot 3). In Line 5, I then adjust the video camera even further: I zoom into the participants' interaction such that I capture as much of the body as possible within the camera frame (screenshot 4).

In the extract above, I have shown how I had to manage dual roles, one as attending to Aunty, and the other as attending to the children's interaction. The interactional work undertaken also creates camera technical challenges experienced by me in navigating both participation frameworks. In the next segment, I analyze two extracts, but I turn the analytical focus to Alex and examine his attunement to the camera moment-by-moment. Bridget and Alex's interaction involves the affective co-engagement of its participants in a constitution of intimacy (M. H. Goodwin, 2017). Such interactions are challenging to capture not only because they require careful attunement of the camera to the interaction, but also because participants have to feel comfortable enough to display such intimacy to an observer.

The phenomenon of 'doing being observed' in video ethnography data has long been documented and theorized. In Harvey Sacks' *Lectures in Conversation* (published posthumously in 1992), Sacks discusses an excerpt from the beginning of a group therapy session, where participants attend to the microphone in a theatrical, play-like fashion. In a similar vein, the researcher becomes an audience member to be entertained by the siblings once she begins the recording process. The following extract describes the same interaction as the one analyzed above, but the analysis instead focuses on Alex.

Extract 3

```
1      AUNTY          |No|thing |leh::.
```
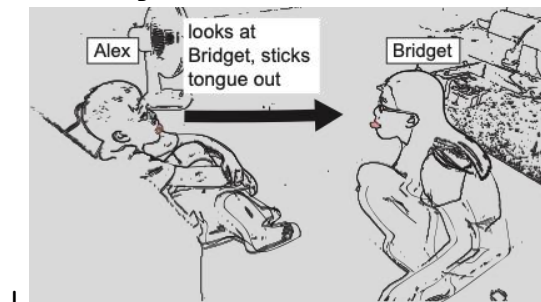

Figure 3.1
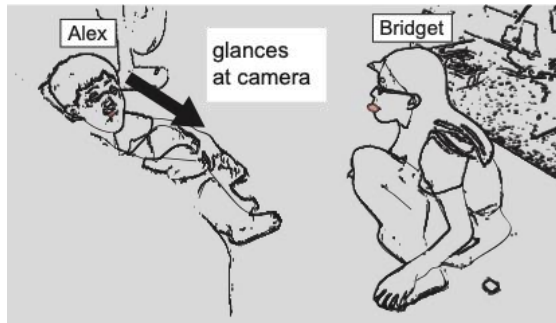
Figure 3.2
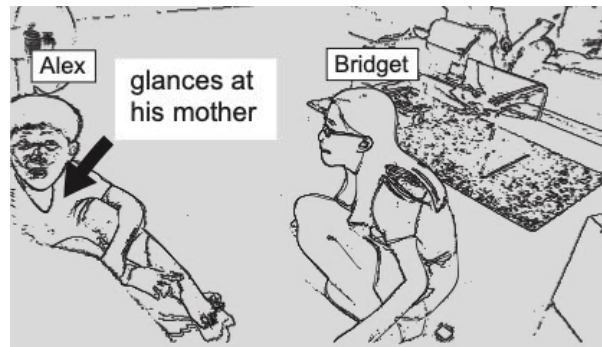
Figure 3.3

```
2      RACH              It's okay lah. (.)
```

As seen in Extract 3, just as the video recording begins, Bridget sticks her tongue out at Alex. Her invitation to Alex seeks playful collaboration from him, and he imitates her tongue-protrusion gesture (Meltzoff & Moore, 1977) by also protruding his tongue (Figure 3.1). In Line 1 when Aunty exclaims "nothing leh", Alex shifts his gaze from Bridget towards the camera (Figure 3.2), showing his awareness of being observed. Alex then shifts his gaze again towards his mother (Figure 3.3). Alex's shift in visual attention to the camera and then to Aunty demonstrates an awareness of the ongoing participation frameworks, the first of him being observed and the second of Aunty's conversation with me.

Alex's shifts in eye gaze are significant when considering his Autism diagnosis. Despite gaze aversion in face-to-face interaction being common in Autistic interaction, Autistic individuals have been shown to be deliberate in eye gaze shifts for a variety of reasons including to reduce stress (Jaswal & Akhtar, 2019), and even as an interactional resource (Dickerson et al., 2005; Korkiakangas & Rae, 2014; Dindar et al., 2017). Alex's shifts in eye gaze in this data indicate his understanding of the complex interactional dynamics at play.

As a researcher, my own onsite attunement to the interaction between the siblings can be argued to sanction and even encourage social interaction. It is also clear that Alex is cognizant that he is receiving the attention of the camera. Furthermore, my involvement with Aunty in one participation framework and the siblings in another allows for the siblings' interaction to unfold independently without engagement with Aunty. In the moments immediately after Extract 2 and Extract 3, the following interaction occurs between the siblings. They orient their faces to the camera as the sequence unfolds in a performative act of doing-being-observed.

Figure 4
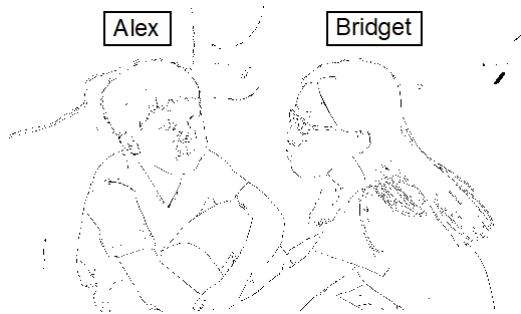
Figure 4.1

Figure 4.2

Figure 4.3

Figure 4.4

In Figure 4.1, Bridget inches even closer to Alex, puffs out her right cheek, and extends it to him. By so-doing, Bridget orients her face towards the camera. Alex imitates Bridget by puffing his right check out (Figure 4.1). Both Alex and Bridget lean their bodies toward each other, and Alex de-puffs his right cheek, puffing up his left (Figure 4.2). As Alex does so, he looks directly at the camera. Alex and his sister lean towards each other in Figure 4.3, bringing their puffed cheeks towards one another. When their cheeks touch, Alex glances at the camera (Figure 4.3). As they move apart again, Alex and his sister close their eyes and release the air from their cheeks (Figure 4.4). Alex's and Bridget's interaction is affectionate and intimate, and their faces and bodies are oriented to the camera as they share the moment.

As I have demonstrated in this section, the presence of a camera can occasion an expectation for an interaction to unfold. Alex's acute awareness of the camera is evident through his explicit shifts in eye gaze throughout the video recording. I have also shown how the camera could have played a significant role in engendering particularly affectionate, play-like actions from the siblings, performed for the camera. I have discussed the multiple participant roles I play within different participation frameworks and how I attune to each of my participants differently, cooperating in their respective activities-in-progress. By surfacing my multiple participant roles during the data collection process, I have demonstrated how my own embodied actions are inextricably intertwined with the local contextures I document. Alex's ability to participate in such affectionate interaction, and his acute awareness of the participation frameworks at hand, defy clinical characteristics of Autistic individuals as having an inability to emotionally reciprocate (DSM-5, 2013).

3.5   Ethical dilemmas in blurred participant roles

I have shown in the previous example how the act of recording itself comprises a participant framework. The researcher's work requires navigation of onsite participation frameworks while managing camerawork that is attuned to the Autistic individual. The complexity of the researcher's work can sometimes be made even more challenging when unanticipated, difficult events occur during data collection. For example, how should the researcher position herself during situations of tension and distress (see also Wootton, 2012) that may emerge during data collection? If, as seen in the above section, Autistic individuals are aware of the intricate participation frameworks that exist during data collection, what are the implications of the researcher's involvement in an ongoing scene?

In this section, I demonstrate how the multiple participant roles of the researcher during data collection undoubtedly highlight pertinent ethical issues in conducting EMCA video-based fieldwork on Autistic individuals. I hope that this section makes a contribution in uncovering some of the ethical dimensions involved in data collection.

In a recent 'ethical turn' in anthropology, ethics and morality have been foregrounded as "co-constructions of the observer and the observed" (Fassin, 2014; p. 432), and themes such as vulnerability and suffering have been explicitly invoked and discussed in a range of activities (e.g. Throop, 2010; Zigon, 2011). The researcher, through the concept of an *ethnographic epoché*, is invited to actively extend the limits of data interpretability so as to include her own subjectivity and to attend to her self-experience (Throop, 2012). The approach taken in EMCA seeks to elucidate the tacit knowledge-base of participants, and how their local contingencies affect their behaviors and interactions (Watson, 2006). In the following analysis, I first analyze, as accurately as possible through EMCA, the unfolding scene and my participant roles within it. In the spirit of ethnographic epoché, I then reflect upon the blurred positionality of these participant roles and the ethical dilemmas that are unearthed as a result.

The extract of focus in this section involves mounting tension between teacher and student, and eventually a display of heightened emotion, which I will call a "distress display". Although my purpose for conducting fieldwork was to study Autistic interaction more generally, during data collection I encountered instances of distress displays. I understood that these displays could happen, but I did not anticipate the unpredictability, frequency, or intensity of the displays when I conducted fieldwork in the institution daily. Whereas the invocation of 'distress' in this episode suggests that the person enacting the display is in distress, I use the term to posit that these are observable displays of seeming distress, not if the individual is necessarily experiencing distress itself. In the interaction examined below, taken about one and a half weeks into the data collection process, two classes of 12 students and 4 teachers are out for a morning walk around the Autism institution, an activity that is a part of their morning routine at least once a week. The walk itself takes place on a long public pathway in between residential houses, with rows of plants and trees running down both sides. The group has been walking for about half-an-hour that morning, and students and teachers alike are traversing at varying distances from one another (Figure 5).

Figure 5

Teacher holds Sam's
hand and instructs
him to return the
hat of his classmate

Sam   Teacher
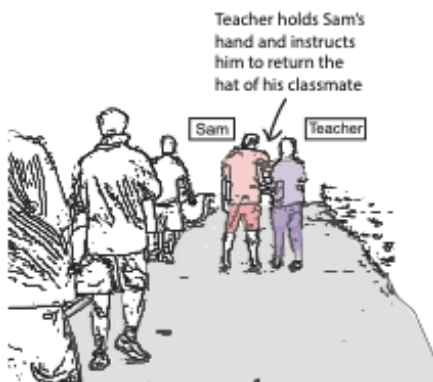
Prior to the data extract, Sam, a 26-year-old non-speaking male Autistic student at the institution, had just grabbed the hat of another classmate. The student who lost his hat appeared unbothered and continued walking ahead. Sam's teacher, a female in her 20s, puts pressure on Sam to return the hat (Figure 5), issuing verbal instructions and using various forms of control touch (Cekaite, 2015). Upon examining the larger corpus, it seems Sam often takes others' personal items and is then asked to return it by his teachers. In this episode, Sam's teacher issues verbal instructions to return his classmate's hat, but she is met by continued resistance from Sam. Because the teachers and students are outdoors in a public area, the teachers' top priority is to ensure that the activity of walking proceeds smoothly, and that risk toward the students or the public is minimized. When Sam sprints off, he presents a risk to progressing the activity, and his teacher runs after him. She catches up to him and grabs his shirt to hold him back. Figure 6 depicts the moment-to-moment sequence of events that follow.

Figure 6

Teacher grabs
Sam's shirt

Sam

Teacher

Sam turns around and
tries to grab teacher's hat

Figure 6.1   Figure 6.2

Sam tries to grab
teacher's glasses, and
she pushes him away
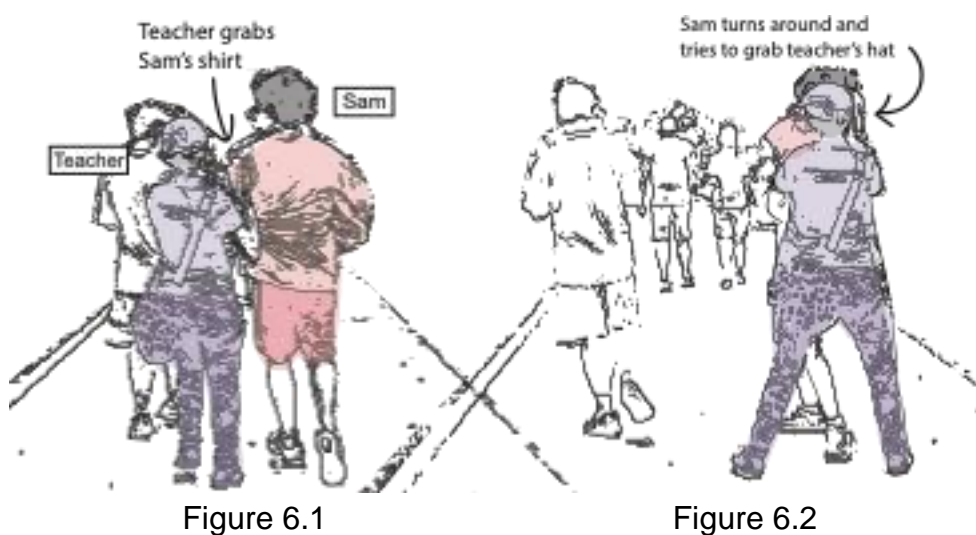
Figure 6.3

In Figure 6, the teacher has just caught up with Sam and grabs his shirt (Figure 6.1). Once the grabbing occurs, Sam immediately turns around and attempts to grab his teacher's hat (Figure 6.2). The teacher spreads her feet into a wider standing stance, pushing Sam away from her. Sam then attempts to grab his teacher's glasses (Figure 6.3). His teacher leans back and pushes him away from her but continues to have a strong grasp on both his shoulders. From Figure 6.3, it is clear that the teacher is attempting to prevent the grabbing of her hat, and possibly, even to protect herself as Sam attempts to grab her items. By maintaining a hold on Sam's shoulders, she is also continuing with a form of control touch to prevent him from running away as he did earlier. Both Sam and his teacher push their forearms against one another: Sam's teacher keeps her hands on Sam's shoulders, her own elbows locked at the joint so as to keep Sam at a certain distance from her. The tussle between Sam and his teacher lead to the interaction in Extract 7.

Extract 7
```
52   Teacher      |°no. Stop. (.) Stop.°
```

Figure 7.1

```
53    SAM            Haiyah:::::::::::::::::

54                  |((flings body sidewards))
```
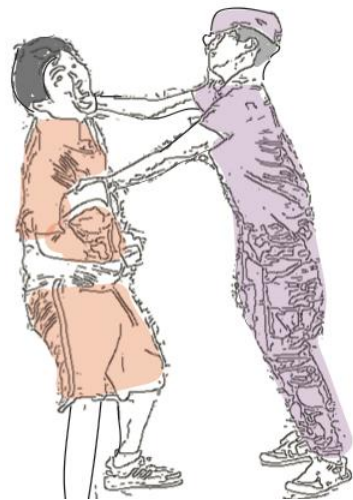

Figure 7.2

In Line 52, Figure 7.1, Sam and his teacher are in a face-to-face spatial configuration (Kendon, 1990) with the teacher's hands on Sam's shoulders and Sam's forearms resting on top of his teacher's forearms. Both are staring into each other's eyes as the teacher softly pleas with Sam to stop (Line 52). Both face each other for a brief moment before Line 53, where Sam screams "Haiyah:::", elongating the vowels in his vocalization together with fluctuations in prosodic contour. Sam's body simultaneously flings outwards toward the direction of the camera (Line 54, Figure 7.2).

The researcher, being attuned to the ongoing interaction, is in a tricky position when the above episode unfolds. During data collection it can sometimes be impossible to make quick decisions about recording: I did not realize at the time that a distress display was about to happen. It was only after, during data analysis, that I was able to unpack the unfolding events. Reviewing this data, perhaps a first pertinent ethical question would be whether or not I should have filmed this segment at all. The increasing mutual tension between Sam and his

teacher clearly cumulated to the distress display. However, given that the camera can occasion doing-being-observed and that the Autistic individual is sensitive to the participation frameworks at play, the presence of a camera during this sequence could have been involved in the unfolding circumstances. In this sequence, Sam in Line 54 flings his body towards the camera before dropping onto the floor, suggesting that there is a possibility Sam was orienting to the camera. In the moment of data collection though, I was not able to predict this outcome of the interaction.

Conversely, documentation of these difficult moments is valuable in revealing 1) how autistic emotionality is embedded within social interactional contexts, and 2) how the otherwise tacit codes held by the participants play out in everyday circumstances. For example, Sam's outburst could at first glance be categorized as a 'meltdown': an intense emotional response to overwhelming circumstances, characterized by a complete loss of control (Lipsky, 2011). Sam's possible awareness of and orientation to the camera during his distress display suggests that he may have had more control over his behavior than what is otherwise suggested by a meltdown.

Through the above analysis, it is clear that Sam and his teacher are in misalignment in terms of their agendas. The teacher's priority lies in teaching Sam not to take others' possessions and to return items to their rightful owners. Sam's priority, on the other hand, lies in holding onto the hat, and he continues to struggle against complying with his teacher's agenda. The extract reveals the ways in which certain Autistic behaviors are responded to. The teacher meets Sam's mounting resistance with repeated verbal instruction and various forms of control touch. In addition, her insistence that Sam return others' belongings reveals how teachers may hold normative moral codes, such as returning others' property, even if prioritizing such codes may lead to distress. It is unclear whose moral codes the teacher is acting upon: Is the hat-returning her own personal prerogative, the Autism institution's rules, or perhaps even influenced by the larger medical model of Autism that presents larger institutional forces beyond this specific institution? Any of these factors, or a combination of factors, could have played a role in the teacher's insistence. This data extract is but a starting point toward unpacking the multilayered socio-cultural and socio-political influences underlying practices that govern Autistic behavior.

Another issue that the above extract raises involves the teacher's use of control touch on Sam. There are practical constraints present at the site, namely the ratio of teachers to students which is 1:3, the small size of the teacher in comparison to the adult male student, and the Autism institution's regard for keeping order amongst students and moving forward with the day's schedule. Through the sequential unfolding of the interactional sequence presented in this section, it becomes clear that the teacher resorts to control touch as an attempt to more easily maintain order in this public setting, and also to protect herself. The practical circumstances that shape this sequence of events bring to light the daily challenges in day-to-day life within this institution.

Situating this data within the larger literature on Autism surfaces more complex issues. When considering the hypersensitivity of Autistic individuals to touch (Baron-Cohen et al., 2009; Fitzgerald, 2013; Sapey-Triomphe et al., 2019), the teacher's use of corporeal control may have contributed to the student's distress. Such data begins to unpack the larger implications behind how Autism is defined institutionally and how certain behaviors are

responded to in educational practices. Autistic scholarship such as Nolan and McBride (2015) discuss how in the medical institution, the Autistic sensory experience is constructed as a disablement. The rhetoric of deficit-driven medical models of Autism pathologizes the 'lived body' of the Autistic, which may have an influence on educational practices involving control touch. Examining the management of Autistic bodies in interaction supports establishing a Goffmanian basis for Autism diagnosis based on 'local interaction order' rather than the traditional Foucauldian-style accounts behind the clinical label of Autism (Maynard & Turowetz, 2017). Distress episodes such as the one analyzed above unveil socio-interactional contingencies to Autistic emotionality. These analyses can play a crucial role in redefining Autism as a starting point for the reconceptualization of educational practices that situate Autistic sensibilities within co-participation.

There is much value in capturing these difficult interactions on video. However, the filming of such interactions is delicate and necessitates caution on the part of the researcher, who has the potential to further perpetuate Autistic disablement. Further ethical issues ensue after, when I, as the researcher, am summoned to be involved in the unfolding scene.

Extract 8

```
55
```
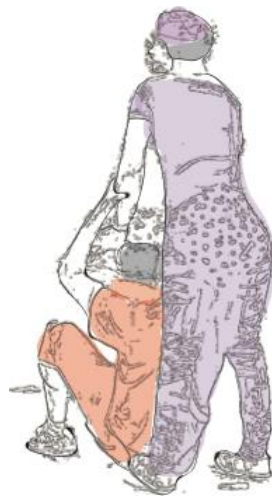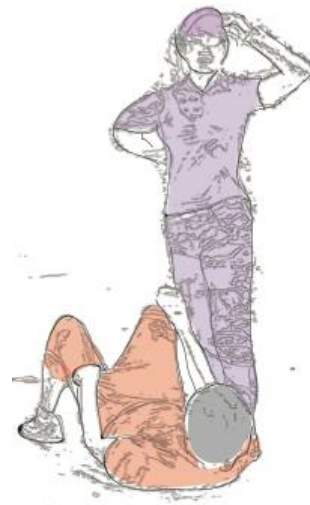


```
         Figure 8.1              Figure 8.2
```

```
56   TEACHER      Can help me give it to=
57   RACH         =Yah can
```

After Sam flings his body toward the camera, he then turns around and sinks his body to the ground as in Extract 8, Line 55. In Figure 8.1, Sam's teacher loosens her grip on Sam's forearms. In Figure 8.2, she turns around. Behind her and in front of her is a stretch of path, and all the other teachers had already walked far ahead, leaving Sam and his teacher behind. The teacher therefore turns to me and summons me into achieving her mission of hat-returning (Line 56). My utterance "Yah can" in Line 57 latches onto the teacher's and I comply with the request by turning off the camera and taking the hat. In my actions it is clear that I am responding to the needs of the teacher in these unforeseen circumstances. However, my alignment with the teacher presents some ethically conflicting consequences. Even

though Sam has just let out a distress display, and is now lying on the floor, the teacher continues to prioritize the returning of the hat. Prior to line 56 and 57, Sam and his teacher have misaligning agendas that are sustained throughout the interaction and that eventually lead to Sam's distress display. My alignment with the teacher means that I enter into a participation framework with her that involves rectifying Sam's violation of the normal ethical code of respecting the property of others. By complying with her, I inadvertently demonstrate my stance (M. H. Goodwin, 2008) against Sam's goals and partake in fulfilling the teacher's objective. Of significance is also the fact that I, presenting as a neurotypical adult, align with the neurotypical adult teacher without centering the autistic participant in the interaction. The ethical bind of the researcher is precisely in her blurred positionality as a researcher as she is co-opted into the activities of the institution.

In the above sequence, I analytically explicate the participants' tacit knowledge base about proper adherence to the ongoing interaction, including my own as a researcher in the scene. In light of my participation in the scene, I inevitably partake in the moral code set forth by the teacher. This data raises important questions. Is Sam responsible for his actions as a competent knowing actor? Is the teacher of a person with vulnerabilities responsible? What is my responsibility as a researcher in this scene? As an EMCA researcher, my role as a bystander shifts when I become a ratified participant. By returning the hat, I am complicit in my participants' moral code, whether it is shaped by the teacher's own practices, the rules of the Autism institution, or the larger medical institution within which Autism is defined.

3.6   Discussion

The ethical role of the participant observer in bringing light to human suffering and vulnerability has been present in EMCA and anthropology studies of medical, legal, and other institutions. For the EMCA researcher, studying the Autistic population surfaces questions that are core to the nature of video-based fieldwork. In this article, I have shown how the EMCA researcher can play an active role in negotiating and shaping the very interactions being investigated. I begin by demonstrating how during data collection, the researcher has to undertake complex interactional work by managing multiple participant roles in different simultaneously-occurring participation frameworks, while orienting the camera to ongoing interactions. I show how an Autistic child is aware of these multiple participation frameworks and performs doing-being-observed. Participants' awareness of the camera have ethical implications in other more difficult recording circumstances. I unveil the ethical nature of participation frameworks as they are created moment-by-moment within the data collection process. Ethical dilemmas emerge when decisions to continue filming or not have to be made, or when the researcher enacts one participant role over another when she participates in the ongoing scene.

EMCA methodologies have much potential to contribute to a deeper understanding of Autism in documenting, accurately analyzing, and clarifying the social interactions that unfold in sometimes conflictual circumstances. In my analyses, I have shown how it is not always possible to anticipate potential ethical issues as they unfold in the moment. Ethical considerations of the researcher therefore extend beyond data collection and lie precisely in how the researcher analyzes and interprets the data. A notable example of ethical

considerations beyond data collection lies in another piece of data, which involves Sam having a meltdown in a corridor. Because Sam had two teachers with him, there was no need for me to provide help. However, halfway through the recording, Sam stops screaming, turns to the camera and says what might have been, "get out." I did not realize at the time that Sam might have addressed the camera or me until I had reached the transcription phase. In this case, I eventually decided to remove the video from my corpus. Beyond data collection, the process of careful EMCA transcription is itself theoretical (Ochs, 1979) and an ethical endeavor. In the future, clear boundaries with participants about researcher-involvement should be set at the very start of data collection. Ideally, a member of the target population should participate in the design of protocols for ethical data collection practices, and perhaps even in the data collection process itself (Stack & McDonald, 2014; Tanabe, 2018).

In developing a professional vision (Goodwin, 1994; Katila & Raudaskoski, 2020) for the researcher of Autistic interaction, this paper draws attention to the ethical implications of the researcher's moment-to-moment participation in the data collection process. Issues examined in this work should be discussed in relation to other important ethical discussions on other aspects of research with vulnerable populations, such as assuming competence to consent (Danby & Farrell, 2004) through accessible consent-taking (Cameron & Murphy, 2006; Speer & Stokoe, 2014), anonymization of data (Mondada, 2014), and avoiding ableist language in discussing vulnerable communities such as the Autism community (Bottema-Beutel et al., 2020).

Leaving oneself open to the lived experience of one's participants means making oneself vulnerable to transformation through research practice (Liberman, 1999; Paoletti, 2014; Throop, 2018). Through the process of collecting, analyzing and interpreting data, the EMCA researcher is continually developing her learning much like other occupations: she becomes a professional within a community of practice, positioning herself and expressing different practice-linked identities in countless existential spaces (Raia, 2018). For the EMCA researcher, ethical issues at the data collection phase continue into transcription and analysis, where the data collection experience is relived and replayed through to publication and beyond. Given the involvement of the researcher in the local contextures of the data and the ethical dilemmas they may face, there may be a form of emotional labor (Hochschild, 1979) involved in video ethnography research (Shaw, 2019). I invite more discussion on how academic communities of practice can play an active role in preparing and supporting scholars wanting to partake in work of this nature through ethical dialogue, and the prioritization of researcher wellbeing.

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Help me only once more to find
a real quiet place where wonderful
bonds of love begin, and knowledge of every kind,
to improve my mind, be rich and plentiful.
Real truths taught, equal opportunities for all,
seen as a person with much to contribute,
not as someone needing to be fixed, only to break apart and fall,
living only a life of loneliness and solitude.
A basic education in my life I daily miss,
such a school for me does not exist.
- fifi coo, 4 July 2016

4 The sound of interpersonal touch: Interactive stimming between non-speaking autistic children and their mothers

4.1 Abstract

Non-speaking Autistic communicators are immersed in a world that prioritizes verbal speech as social action. The prioritization of referential language and speech can be witnessed in autistic individuals' everyday interactions with speaking others, as well as the biases in the Alternative and Augmentative Communication (AAC) tools they are provided with. The study asks two questions: 1) Instead of intervening on the child, how can we intervene on their environment so that rich, intimate, embodied interactions can be surfaced? 2) What will happen if we notice and attune with the actions of the more vulnerable communicator?

Prior work has shown that interpersonal touch between Autistic children and their siblings/peers, and contexts where music-making is forefronted, is when intimate interaction between autistic individuals and others can occur. The Magical Musical Mat (MMM) is an interactive environment that maps interpersonal touch to musical sounds. When two people sit, stand, or lie on floormats, music plays and changes dynamically according to various touch-based gestures people produce together.

Conducting video-based fieldwork vested in cycles of design-based research, this mixed-methods study evaluates three iterative cycles of a five-day empirical intervention, with three autistic children and their mothers, designed to surface and forefront interaction beyond speech. In the baseline phase, with a research team, I collect 1-2 hours of video recordings of the child's daily home life, in combination with ethnographic interviews with the parents. During the intervention phase, over three separate sessions of 1-2 hours each, the MMM is brought into the environment and customized for each child. The mat is brought into the homes of the autistic children, where children and their parents are invited onto the mat together. Their interactions are filmed, then evaluated after with an approach grounded in the study of embodied interaction. Improvements are made to the MMM as well as researcher interactional practices alongside each iterative cycle. During the last session with each family, I conduct a close-out interview with the parent and play video clips from the previous sessions for them and their families.

Results show that across all participants, especially when the dyads first encounter the environment, parents produce multiple invitations to invite the children to touch their open palms, and otherwise perform light touches on their children's legs. Children, on the other hand, assert the project of 'figuring out' the novel environment themselves, in their own time and by their own means. The forefronting of interpersonal touch in this environment eventually orients the parents towards the sensory activities/practices of the children. The most sustained, mutually elaborative interactions involve parents attuning to the stims of their children by facilitating their expressiveness, thus co-creating a pleasurable sensory experience together. Sound allows the autistic children to become aware of the presence of their stims. Their stim movements change and became more varied and expressive. They also add 'embellishments' to the rhythmicity of their repetitive behaviors. Parents and children enter into longer patterns of repetitive cycles together, laminating action upon action, with the cycles evolving over time.

This study bears theoretical, practical, and methodological implications for the study of Autism, and proposes the importance of a reflexive research agenda when research is conducted with vulnerable populations.

4.2   Introduction

The asymmetry between non/minimally-speaking individuals and their interactants begins from the earliest years of a person's life: those who do not typically use oral-acoustic speech are often born into households where participation in verbal conversation is a means to participate in daily life. C. Goodwin and M. H. Goodwin (2004) posit that privileging the stream of speech as an analytical focus for participation in interaction concomitantly denies full status of a participant who lacks fluent, complex speech ability. Individuals who communicate multimodally and not through oral-acoustic speech production, competently interact with others through elaborate, temporally coordinated collaboration with others (C. Goodwin 2004). By shifting the analytical focus from speech to the organization of situated action, the rich cognitive lives of individuals who bear a variety of diagnoses impacting speech production—aphasia, cerebral palsy, dyspraxia, to name a few—have been uncovered beyond the traditional model of talk.

At an even greater disparity when interacting with others is the minimally/non-speaking autistic child, who additionally carries the label of "autism", clinically defined by a "deficit in social communication" (DSM-5, 2013). In recent years, there has been a shift within scientific literature towards reframing the 'lack of social intent' associated with autism as an issue involving experienced disjunctures between individuals of different dispositional outlooks, such as autistic and non-autistic people, as they participate in social interaction together (Milton 2012). These interactions have been forefronted as the locus of the 'double empathy problem': "a disjuncture in reciprocity between two differently disposed social actors" (Milton 2012: 884). Such disjunctures occur for a variety of reasons, but three are particularly relevant to the interactions of non-speaking autistic individuals. Firstly, the production of various forms of autistic bodily action—repetitive behavior (stimming), and repetitive vocalizations (ecolalia)—are deemed idiosyncratic by their diagnosis (DSM-5, 2013), conceived as anti-social by therapy and educational practices (Leekam, 2012), and often the subject of social stigma (Ochs, 2015). For these reasons, their behaviors are often interpreted as removing them from participating in social interaction, or else distracting to the interaction at hand. Secondly, many autistic individuals find sustained eye gaze with others painful, and also produce less pointing than other children, thus they may be interpreted as disengaging from an interaction at hand. Thirdly, autistic individuals are known to pursue strong special interests, even from a young age. An autistic child who does not produce speech may be interpreted by others to be deeply entrenched 'in their own world', especially when they display a strong preference for their interests than engaging in challenging conversation with speaking others.

Immersed in social interactions where speech is expected, the social actions of autistic children who do not produce speech may go unnoticed, or otherwise misinterpreted. Furthermore, the bodies of autistic children become the subject of control towards specific communicative norms, whereas connection between people most fundamentally begins with two bodies coming together in compresence. In this study, I attempt to flip the narrative on

autistic interaction. Rather than have non-speaking autistic children accommodate to the dominant modality of speech, how can we as interlocutors and researchers notice, embrace, and celebrate the social actions of the more vulnerable communicator?

4.3   Prior communicative solutions for non-speaking autistic individuals
The overwhelming slant towards verbal conversation as *the* means to participate in interaction is evident not just in everyday interaction, but also in therapeutic practices and tools designed for those who do not produce speech. Prior solutions to aid in the communication of individuals with speech disabilities have centered around Alternative and Augmentative Communication (AAC) systems, which are tools that serve as an alternative to or augmentation of an individual's speech. These may come in the form of low-tech devices, such as picture cards with words on them, or high-tech devices, such as speech-generating devices.

When AAC systems are used in everyday social interaction, its users often face specific challenges in attempting to achieve intersubjectivity, and in sustaining the attention of their interlocutor(s). Often, even a fluent AAC user of a speech-generating device requires some time to generate an utterance. But verbal conversation moves fast and speaking interlocutors do not wait. Extensive studies on turn-taking have been conducted on individuals using speech-generating devices, who require time to type a response. While preparing a response, verbal conversation may have moved on, or others may step in to pre-emptively complete the user's sentence, not always to accuracy (Savolainen et al., 2020).

The social actions of the augmented interactant fundamentally incorporate the actions of their interactional partners. In their interactions, electronic devices, family members, and bodily communicative resources are fused into one dialogical, collaborative structure (Auer & Hörmeyer, 2017). Those who do not produce fluent speech augment their communication by borrowing others' voices, whether through trailers for films, photographs, AAC devices (Savarese, 2022), or through co-constructing single conversational turns with speaking interactants (Bloch & Beeke, 2008; Pilesjö & Rasmussen, 2011), or through invoking family members through gesture and prosody to tell complex stories (C. Goodwin, 1995, 2004). The actions of these partners become an essential interactional resource for AAC users, but also allows these partners to dominate the interactional space. Often, these interactional partners are the gatekeepers for whether the interaction progresses and may risk interpreting the augmented speaker's verbal actions as aligning with and advancing their interests (Kurlenkova, 2021).

The dominance of verbal conversation as the means to interact has spawned generations of assistive communication devices and interactional practices that are centered around speech, allowing speaking interlocutors to maintain control over the flow of conversation. Although spoken symbolic competence is often the indicator of a rich cognitive and social life, the interactional practices beyond speech are what really is a primordial site for human social life (C. Goodwin, 2004). Even conversants who use speech-generating devices also use gesture, vocalizations, body, and other resources for interaction, in combination with these devices (Fulcher-Rood & Higginbotham, 2019). The rationale behind many therapy practices around communication is predicated on a pervasive approach to communication that prioritizes linguistic form over interactional function (Yu & Chen, in

press), and this focus on referential language has biased AAC interfaces towards unnecessary complexity. Whereas AAC systems focus on indexical language structures geared to generate speech, they inherently neglect other more fundamental ways of connecting with others.

Often, the initial barriers in using AAC systems may render them overly effortful, if not impossible to use. AAC systems' exclusive focus on generating linguistic forms as social action has borne three negative consequences: (1) AAC user interfaces are constrained to an array of symbols and grids, whose use is predicated on effective sequencing skills, excellent memory, and motoric dexterity, thus imposing high cognitive and motor demand (Light & McNaughton, 2019); (2) AAC interventions position the body as serving verbal output, and not as communicative itself, and (3) AAC interventions are prone to configure interactional contexts where the AAC user must accommodate to their interlocutor's communicative medium of preference (oral-acoustic conversation). Because AAC user interfaces are complex to use, they require a steep initial learning curve before any first interaction with the device can happen. Their continued usage also requires cognitive and motoric effort on the part of the AAC user, who likely has an accompanying disability around fine motor control, and who would struggle to gain fluency with the complicated interface. Furthermore, these devices impose further motoric constraints on the autistic individual, whose 'idiosyncratic' bodily movements are already inhibited by others. These devices further constrain their bodily movement in the servitude of speech output.

AAC devices have been additionally found to be limiting for many non-speaking autistic individuals, whose responses on AAC devices are often constrained the user to communicating basic wants and needs (Mirenda, 2008). These systems are also biased towards relying heavily on screens, presuming visual access to the information it reflects, thus also presuming that the user has access to it visually. What will happen if, instead of beginning from referential language, we began from interaction as it occurs multimodally?

4.4   Empirical work on the everyday interactions of autistic multimodal communicators

To presume communicative competence is to assume non-speaking autistic individuals interact with others multimodally, whether through writing, typing, gesture, or through many other means. As such, non-speaking autistic individuals are autistic multimodal communicators (Savarese, 2022).

For the study of autistic multimodal communicators, the analysis of video data has much potential to surface facets of embodied interactional practices that may otherwise be missed, and to provide a rich account of sociality beyond speech. Prior empirical work on the interactions of autistic individuals has demonstrated the specific challenges autistic individuals face in their everyday interactions, as well as their competencies and creativities in navigating their complex social landscapes.

Some of the challenges these individuals face in everyday interaction are due to a pervasive expectation that their social actions count only if produced verbally. Matt, a 5-year-old autistic child who is able to speak in 1-2 word utterances, is demonstrated in Chen (2022) to produce gestural requests, but these are ignored in favor of speech production.

Figure 1 (adapted from Chen, 2022): Matt is prompted to speak
`el. (.)`

In the interaction featured in Figure 1, Matt has gesturally requested that his mother help him open his cereal packet. Instead of immediately granting Matt's request, his mother halts the progressivity of their interaction, contingent upon Matt's ability to vocalize his request. She puts a hand under Matt's chin and looks at him. She says "help?" with rising prosody, to which Matt responds with "open". It is only after he produces this verbal utterance that his mother grants his request. In another interaction between the pair, an interactional sequence is initiated by Mom, but Matt is facing away from her and stimming: he is turned away from her, involved in a cacophony of rapid, periodic movements incorporating all parts of his body. Matt produces repeated cycles of various bodily movements in an excitatory shimmer of rhythmic fluctuations, but gradually ceases his stimming in order to turn towards his mother and engage in continuing the verbal sequence with her. Through careful analysis of the movements of Matt, it is possible to observe that he accommodates his behavior to mom's participatory demands. The ceasing of stims due to participatory demands has also been empirically observed in institutions, where stims are outrightly stopped, and stim objects taken away from the autistic individual (Chen, 2016).

Video-based fieldwork has also empirically revealed the interactional competencies of autistic multimodal communicators. Despite the asymmetry inherent in their interactions, Matt is able to take rapid turns with his mother and spread his verbal output across multiple turns. He can therefore co-construct longer interactional sequences that would otherwise be missed if just his linguistic output was measured. Furthermore, Matt can redirect his mother's attention to accomplish his goals, even if he and his mother have misaligned agendas.

Intimate, mutually elaborative interaction can also happen between autistic individuals and others, if they engage in embodied interaction with others through a modality other than speech. Chen (2021) shows how an autistic child and his sibling participate in affectionate, play-like interaction with one another through touch: they sit opposite one another and touch cheeks, rub noses, and hold hands in evolving cycles of an emerging haptic game. Intimate interaction also occurs in Chen and Cekaite (2021), where an autistic child is teased playfully by his friend. He favorite object—a comb—is taken away from him and transforms into the focus of the game at hand. The transformative role of the comb reveals the child's ability to be flexible and creative with his favorite object. By changing the role of the comb into an object of a game, both the child and his friend come into intercorporeal attunement, affective embrace, and affective collaboration.

The production of repetitive behaviors is one of the diagnostic hallmarks of Autism, referring to a diverse range of movements and behaviors including repeated motor mannerisms, repetitive speech (echolalia), and routines. Kanner (1943), in the first seminal paper characterizing autism, described eleven children who shared a 'powerful desire for aloneness and sameness' (p. 249). The repetitive practices of autistic individuals have since been clinically characterized as restricted and inflexible (DSM-5, 2013; Kanner, 1943), and are therefore cited as compromising their daily living (Lilley, 2018), constituting barriers to sociality (Leekam, 2011). Although traditionally viewed as non-functional, repetitive behaviors have been reclaimed as stimming by the Autistic community, and as a core facet of the Autistic identity (Kapp et al., 2019). Stimming is being re-theorized as an expression of focused engagement through an "intrinsically attractive motivating sensory event" (Nolan & McBride, 2015; p. 1075), a valid coping mechanism (Kapp et al., 2019), an expressive modality, and a mode of experience (Nolan & McBride, 2015).

Besides intimate interaction between autistic individuals and their friends and peers, autistic individuals can also have rich interactions with each other. Autistic autobiographers have coined the term *interactive stimming*—producing rhythmic behaviors together with others—that they describe as an empathetic experience of belonging and relatedness (Sinclair, 2005). Interactive stimming has been depicted as a "form of natural autistic social behavior" (Bascom, 2012, p. 25) that is a valuable mode of self-expression, a powerful vehicle for communication, and a bridge to forming friendships and establishing communities (Bagatell, 2010; Bakan, 2014; Coo, 2018). Thematic analyses of these autobiographies reveal that physical attunement and synchronicity with others are profoundly experienced and emotionally felt (Conn, 2015).

The interactional dimensions of stimming have been empirically examined in a handful of microanalytical data. Through identifying the sequential positioning of taps, Dickerson et al. (2007) shows how the taps of autistic students in therapy can play a significant role in projecting a forthcoming response in interaction. Chen (2016) demonstrates how solitary stims are in fact attuned finely to the social environment, with their frequency and intensity shifting with displays of excitement and distress. Investigating interactive stimming lends itself to better understanding sociality between autistic individuals and others beyond speech, within the expressive modality of the autistic individual. Chen (in preparation) investigates this interactional phenomenon in an autism institution where interactive stimming was found in one context—a drum circle. Autistic individuals stimmed together by amplifying others' rhythmic productions and took risks in interrupting the ongoing soundscape and transforming it. The drums and musical focus of the activity sonically amplified the autistic individuals' stims, which then became more varied and musical in their production.

4.5   The study

Navigating neurotypical norms in daily interaction, the affective interactions between autistic individuals and others could be said to often occur intercorporeally (Merleau-Ponty, 1962), where two or more bodies co-perceive, co-perform, and co-exist through multiple modalities in the world that they inhabit together. To return to the core of social interaction, the human body needs to be embraced as the nexus of experience, so that embodied action

can be grounded as the "active center of cognition, social understanding, and culture making" (Meyer et al., 2017). Autistic multimodal communicators, much like any other interactant, must be presumed competent to coordinate, co-operate (C. Goodwin, 2018), and build action by transforming interactional resources.

Although rich, multisensorial interaction can happen between autistic individuals and their siblings or peers, prior video-based fieldwork has demonstrated that interactions between autistic individuals and their parents are usually heavily slanted towards speech production. This study combines two approaches—video-based fieldwork and design-based research—in implementing and evaluating an interactive environment that is meant to surface rich, multisensorial interaction between autistic individuals and their parents. These parent-child interactions are foundational to an autistic person's life, beginning from their earliest years, and dominating much of their everyday lives. Instead of intervening on the autistic child, how can we intervene on their environment in a way that would best surface rich, intimate, embodied interactions? What will happen if we notice and attune with the social actions of the more vulnerable autistic communicator?

4.6   Description of novel artifacts

Magical Musical Mat (MMM) is a communicative tool that maps interpersonal touch to dynamically changing music and sound (Chen et al., 2020; Chen et al., in preparation). When two people sit, lie, or stand on floormats and establish skin contact with one another, they close and thus activate an electronic circuit. Capacitive sensors in the mat detect their co-produced touch actions, triggering a variety of sounds. Different types of touch, such as holding hands, high-fives, or gentle taps, dynamically and spontaneously change auditory qualities, resulting in a rich diversity of sound-touch expression. Comprising of various floormats, an electronic circuit, and speakers, fuller details of the design and development of the interactive system will be discussed in Chen et al., in preparation. The first iteration of MMM was influenced by Tangible User Interfaces, a design paradigm from the field of Human Computer Interaction that seeks to utilize the natural ability of humans to grasp and manipulate physical objects and materials (Ishii, 2008; Ryokai et al., 2008). Design-based research forum (Abrahamson, 2015) also, at the time, sparked an interest in exploring the use of mixed-media artifacts for embodied learning within iterative design cycles. Compresence through touch and the notion of intercorporeality (Merleau-Ponty, 1962) heavily influenced this initial design, as well as research on the intimate touch practices of families as bodies intertwine, constituting rich fields of copresence (M. H. Goodwin, 2017; M. H. Goodwin & Cekaite, 2018; Katila, 2018).

The initial iteration of MMM was not designed with autistic children in mind, but rather, was an attempt to design for novel interaction between people. Having conducted video-based fieldwork with autistic multimodal communicators, I realized that there was potential for the artifact to be a tool for communication. Specifically, I had studied naturally occurring interactions by autistic individuals that involved interpersonal touch (see Chen, 2021; Chen & Cekaite, 2021), but often these occurred with their peers or siblings, and less so with parents. I had also closely examined the stims of autistic adults in a drum circle (Chen, in preparation), which revealed the attunement of autistic individuals' stims to music. The work of Fitzgerald (2013), which is the first paper exploring touch practices of autistic

individuals, also gave insights into the purchase of ethnographic enquiry into these sensory experiences. The process of developing MMM as a communicative, therapeutic tool thus began.

Figure 2: Timeline of MMM form factor
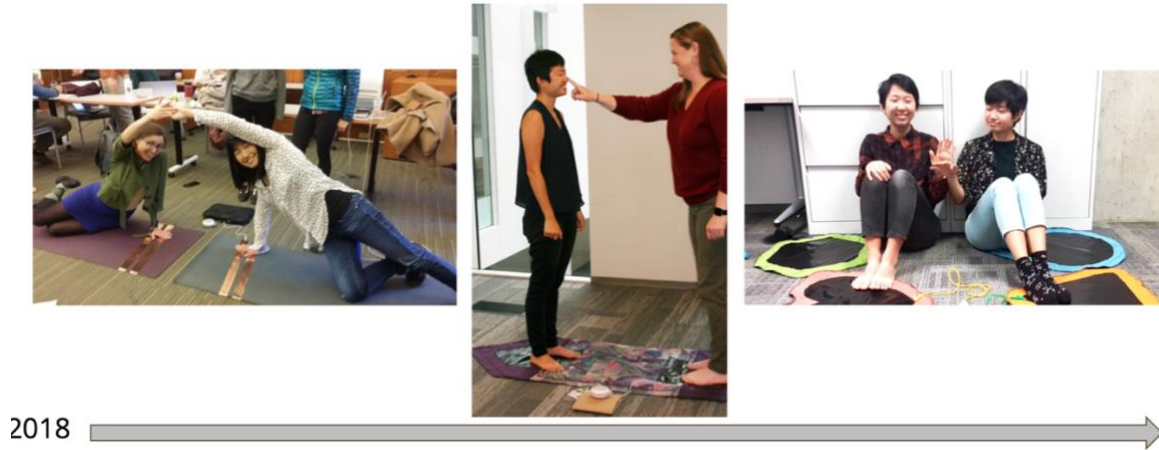
MMM was constructed in on-campus makerspaces and involved crafting and tinkering. In 2019, our team (Rachel Chen and Arianna Ninh) developed the environment further. We ensured the prototype was robust enough, then brought it to a clinic with autistic children and therapists (Chen et al., 2020). Through close observations of the children's interactions, as well as feedback with the therapists, we improved on the form factor of the mats (see Figure 2). The mats were constructed in a variety of sizes, and could be flexibly placed in different environments. In 2020, our team (Rachel Chen, Arianna Ninh, and Rebecca Abraham), created a variety of musical palettes beyond our initial version. We played with pitch variation, tempo, harmonic change, timbre, chords, the ascension and descension of musical scales and other musical properties, mapping sound onto touch-based gestures in different ways. We drew inspiration from the practice of musical improvisation, and thoughtfully curated sonic palettes through MIDI notes. This collection of musical palettes, together with a variety of floormats, were then brought into the homes of three autistic multimodal communicators for this study.

4.7   Methodology
4.7.1   Participants and sites
The study recruited three children diagnosed with Autism (ages 5–14 years) with minimal to no existent spoken language production, and their respective families to participate. The children were recruited from parent support groups and schools, and recruitment was open to the diverse ethnic, cultural, socioeconomic demographics of local communities in Singapore. Eligibility was determined based on the following conditions: 1) A confirmed clinical diagnosis of Autism, 2) informed consent from both parent/guardian and child, and 3) minimal to non-existent spoken language production.

All names used in this study are pseudonyms. The autistic participants in the study are Matt (14-years-old), Nathan (12-years-old), and Chloe (5-years-old). Matt and Chloe are

Singaporean-Chinese, and Nathan is Singaporean-Indian-Chinese. All participants use a combination of Singaporean English and Singapore Colloquial English (Leimgruber, 2013) as the primary spoken languages at home, and some of Chloe's family members use Mandarin Chinese, although they speak to her mostly in English. All the children's mothers were the ones who first contacted me, and the family members who themselves participated in the study. All three children were going to a Special Education school at the time. Nathan and Chloe were additionally receiving Speech Therapy, and Matt was receiving a movement-based therapy based on Feldenkrais.

At home, Matt communicated most frequently with his mother on a low-tech AAC device—an alphabet board—where he would spell out words and sentences to her. Nathan did not have any assistive communication device that allowed for the production of words. Chloe used a high-tech AAC device, a minspeak system. According to her mother, and throughout the study, Chloe used the device to request for food and activities.

When I, the researcher, came into contact with the parents, I collaborated with them to find a time in their schedule that would be ideal. According to prior work on video-based fieldwork with autistic children who do not speak, a number of activities occur at specific timeframes throughout a child's day. At times, unplanned, 'free' time would occur between larger activity junctures, for example, between mealtime and having to leave the house for therapy (Chen, 2022). I found out from parents when these chunks of time would occur, then coordinated with them for my team and I to come at that time, over five days in a span of 1-2 weeks. I also collaborated with parents in finding a physical area in their homes for the study to happen. All three parents suggested the living room, since they would typically spend much time with their children in this common space.

4.7.2   Study design

This study integrates two approaches, namely video-based fieldwork, and design-based research. Video ethnography centered around studying situated human interaction is an approach that involves setting up cameras, or entering a research site with a roving camera (Heath et al., 2007, p. 38). In this study, two stationary cameras were set up at corners of the participants' living rooms, and a roving camera was held by at least one research team member. The video data was supplemented with an ethnographic interview with each mother on the first day of the study.

With video-based fieldwork, various contextual dimensions of a person's everyday life can be observed and unearthed, which can then inform how a design artifact can be customized and brought into their homes. The research team, being a part of the ongoing social and material ecology they are investigating, becomes carefully attuned to their own interactions with their participants during the data collection process (Chen, 2021). Technical decisions with the camera, interactions with participants on the site, and artifacts brought onsite by researchers can all have consequences for the interactions that unfold. Being a team of speaking individuals working with multimodal communicators, the research team immediately enters into asymmetrical relationship with participants who are more vulnerable (Jaarsma & Welin, 2012) than them. Interactions with participants on site, as well as the introduction of new materials into the child's home, therefore require care, sensitivity and consistent reflection. Video recordings provide evidence and accurate grounds for observable

phenomena (Garfinkel, 1967; Sacks, 1992), and additionally allows the research team to evaluate their own interactional practices with participants.

Design-based research, also called design experiments (Collins, 1992) or design research (Bakker, 2018), is a general approach to educational research, in which empirical studies of educational phenomena are vested in cycles of design practice: design, implement, and evaluate. As an intellectual endeavor oriented toward generating and generalizing theory, the design-based research (DBR) approach is focused on "ontological innovation," the hypothesizing and developing of explanatory constructs for, and causal accounts of teaching/learning phenomena. In turn, these ontological innovations inform the creation of potential design solutions for subsequent evaluation. This practice and ad hoc nature of DBR studies, as compared to traditional experiments, promote a genre of theory that is "humble," in the sense that ontological innovation may be contextually circumscribed and under-validated (Cobb et al., 2003). Working in DBR, researchers generate three types of contributions: (1) new and/or refined theoretical constructs and models; (2) new empirically validated educational artifacts and other resources; and, reflexively, (3) new and/or improved heuristic design frameworks (Abrahamson & Wilensky, 2007).

4.7.3   Study procedure

The study underwent three iterative cycles with the three autistic children and their families. The first cycle involved Matt, the second cycle involved Nathan, and the last cycle involved Chloe. Each cycle spanned 10 days, over five separate sessions. Changes between each cycle include improvements to the form factor of the MMM mats, tweaks to the sounds of the MMM, and refinements to our own interactional practices with participants.

Each iterative cycle followed a three-part structure (figure 1). In the baseline phase, 1-2h of the Autistic child's home life during 'free', unplanned time was video-recorded by a research assistant and me. During this time, the child's stimming behavior, interactions with family members, and interactions with material objects and their environment were observed and documented by the research team. A brief ethnographic interview was carried out with the parent during this phase (appendix 1).

Figure 3: Structure of each iterative cycle
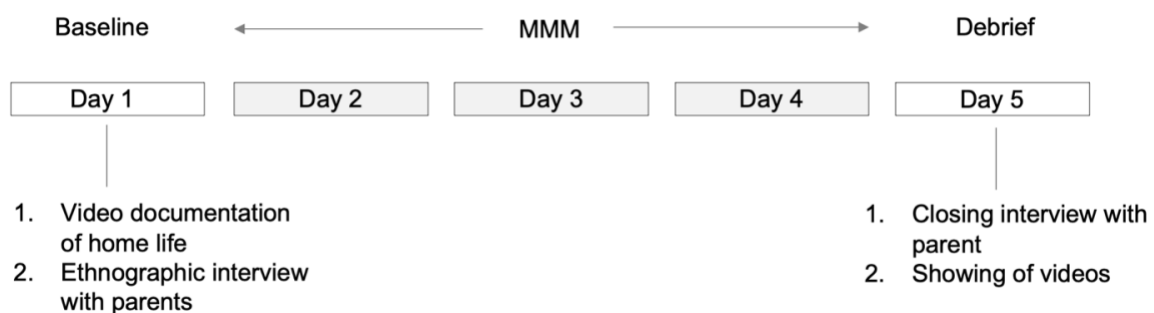
During the intervention phase, I held three sessions with each family. Each session was anywhere from about an hour to at most two hours long and kept flexible depending on how the child was feeling as the session went on. At the start of each session, the research

assistant set up video cameras while I set up the MMM, both in terms of its electronic components and its placement in the living room. As we prepared the environment, I interacted with participants casually, and they came in and out of the space with some curiosity. Once the mats had been set up, I let the participants know that the mats were ready to be used. I stepped aside but sat near the mats just in case the circuitry needed resetting, or any wires came undone in the MMM prototype. Participants were then free to interact on the mat with little guidance from the researchers, and their interactions were video-recorded. Participants were also encouraged to engage or disengage from interacting on the mats as they wanted. In between each of the three sessions with the MMM, the research team would meet and reflect upon how the session went. With the goal of putting our participants at ease, and forefronting the social actions of the child, our team made improvements in three aspects: 1) our own interactional practices with the family, 2) form factor and musical palettes of the MMM, and 3) the placement of the mats in the living room. Minor improvements were made between sessions, but more involved improvements took place with each iterative cycle.

During the last session with the family, I conducted a close-out interview with the parent and played video clips from the last few sessions for them and their children. During this time, parents were free to ask questions, engage in conversation about the study, and let us know how we could have improved the study. All three children came in and out of the space during this last conversation with the parents, and I made explicit that they were free to come into interaction as they wished.

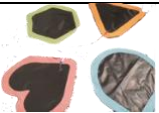### 4.7.4   Trajectory of changes to sociomaterial environment
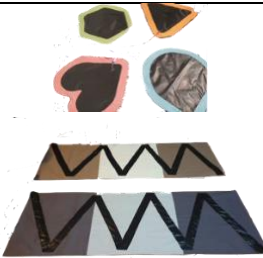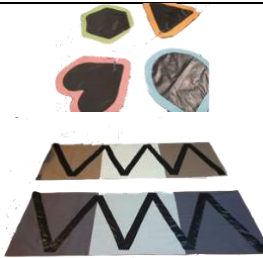
During data collection, the researcher plays a significant role in shaping an Autistic individual's conduct, especially when the researcher enters a field site with a "roving camera" (Heath et al., 2007, p. 38) and becomes a part of the ongoing social and material ecology (Chen, 2021). Even more significant is when the researcher team brings materials that are meant to enact change in the very interactions they are documenting. During each iterative cycle, and between the cycles, improvements to the sociomaterial environment were made. The researcher team (my research assistants and I), as well as the materials we brought into our participants' homes (cameras, personal belongings, and the MMM), all became a part of the sociomaterial environment. Through collaboration with their families, careful observation of their home lives, and thoughtful consideration of their physical home environments, improvements were made over the course of the study to the MMM itself, and to our interactional practices with our participants.

Over the course of each cycle, and between each cycle, improvements were made to the MMM system (see Table 1). Firstly, additional mats were made after Matt's study: instead of having just four smaller mats, we brought back the longer mats. We made these longer mats when we had noticed Matt lying down on the smaller mats. These longer mats, as well as the smaller mats, were brought into Nathan's and Chloe's homes during their time with the mats. Secondly, changes were made to the sound of the MMM through each cycle. Every child started off with the same palette, bass_marimba, which sounds like a piano and ascends and descends a musical scale. This musical palette was chosen because all parents reported that their children loved the piano. The palette bass_marimba was the mode inspired

by similarities between the piano and the marimba and was chosen as the first mode for all the children. Other musical palettes (1-2) were prepared for each child prior to each session with them, and these palettes were put into the MMM system when children and their parents had a long lull in their interactions.

Thirdly, placement of the mats in the environment changed during the course of each iterative cycle. During their first day with the MMM, the mats were placed on the floor of all participants, under their living room fan. The researcher team changed the placement of the mats organically as the study went on. These changes were made in collaboration with parents, and with careful attention to what the children were doing, where they spent time during the course of the study, as well as where interaction with family members typically happened.

Table 1: Changes to material environment

	Matt	Nathan	Chloe
Day 2	Bass_marimba *On the floor, under the living room fan.*	Bass_marimba *On the floor, under the living room fan.*	Bass_marimba *On the floor, under the living room fan.*
Day 3	Bass_marimba Drums Bass_marimba *On the floor in front of the sofa.*	Sustained-chords Drums Bass_marimba *On the floor.* *On the swing.*	Bass_marimba Ode to Joy Drums Ode to Joy *On the floor, under the living room fan.*
Day 4	Bass_marimba *On the floor in front of the sofa.*	Bass_marimba Sustained-chords *On the floor.* *On the sofa.* *On the floor.*	Ode to Joy Star Wars Ode to Joy *On the floor, under the living room fan.*

Over the course of each cycle with the families, our interactional practices also changed. Chen (2021) discusses potentially conflicting participant roles that can arise when a researcher enters a scene, and the ethical issues that arise as a result. When as researchers we are "not ourselves members of historically marginalized populations" (Edmonds, 2021) our

alignment with those in power can perpetuate vulnerability (Chen, 2021). Collecting video recordings, and bringing novel materials into the homes of the children, is delicate and necessitates caution on the part of the researcher who has potential to inevitably further perpetuate Autistic disablement. Throughout the study, I paid careful attention to my participant roles when in interaction with the children, with the parents, and when I addressed both parent and child. When interacting with the children, I made sure to talk to them concisely, and in a way that assumed they understood. I explained each day of the study that they could detract themselves from the study at any time they wished. I bent down to be at their height when interacting with them, so that they feel more comfortable with me. When interacting with parents, I kept the conversation light-hearted, and always did my best to vocalize anything interesting I noticed their child was enjoying.

The participant-observer's and participants' reflexive orientation toward each other constitute a participation framework (Chen, 2021; Goico, 2021). Participants, including the researcher, produce courses of actions which position themselves to perceive in ways that are relevant to the activities in progress (C. Goodwin, 2007). Some notable changes through the iterative cycles involved how we introduced the mat to the participants. When I began noticing the heavy use of control touch (Cekaite, 2015)—a form of touch frequently used by parents to control the bodies of their children—with the first participants, I changed how I introduced the environment to the participants (see Table 2).

Table 2: Change in verbal introduction of mat to participants

	Matt & Danna	Nathan & Ellie	Chloe & Lin
	"When you touch hands, music plays."	"Go ahead and touch each other."	To Chloe and Lin, "The space is open." To Lin, "Ya, you can invite Chloe to touch you."

With Matt and Danna, I had let them know that "when you touch hands, music plays". The strong focus on "hands" in this introduction could have oriented Danna towards Matt's hands. Hoping to encourage more diverse touch-based interactions, when the mat was introduced to Nathan and Ellie, I asked them to "go ahead and touch each other". However, this statement seemed to dictate what Nathan and Ellie should do, and not let them do as they wished. With Chloe and Lin, the introduction was changed slightly. I told Chloe and Lin that "the space is open", but specifically oriented Lin towards inviting Chloe rather than initiating the touch first. I did my best to refrain from creating a situation where children were forced to interact on the mat. When parents sought more help from me during this initial introduction, I therefore asked that parents invite their child onto the mat, emphasizing that it was fine for the children to not want to engage with them. Nishizaka (2009) discusses how learning is a restructuring of the environment that is accomplished through the course of instruction. As participants learnt how to use our artifacts together, we were an essential part of the sociomaterial environment. The video recordings also allowed the research team to be reflexive, and to make small improvements to our interactions.

4.7.5 Analytical procedure

First, data from Day 1 of each cycle were analyzed. Analyses of video recordings from Day 1 surfaced objects the children frequently interacted with, details of their stimming practices, as well as the interactional practices they engaged in with family members. Video recordings were complemented by ethnographic interviews with the parents. Second, I examined each iterative cycle and identified the first instance of collaborative spontaneous activity between the children and their parents. I specifically identified the first interaction that involved both parent *and* child, and that involved mutual elaboration. I only counted interactions that involved the participation of the child, and therefore did not count interactions that received no uptake from the child. Third, within each pair, I then searched for the lengthiest, most sustained interactions between parent and child. These interactions were analyzed microanalytically.

Central to this methodology is the "systematic investigation of the different kinds of semiotic resources and meaning-making practices that participants themselves attend to and treat as relevant as they build action within interaction together" (Streeck et al. 2011: 4), where intercorporeality is presupposed (Meyer et al., 2017), and action is built co-operatively (C. Goodwin, 2018) within larger sequences of embodied choreography (M. H. Goodwin & Cekaite, 2018). The analysis combines microanalyses of embodied action within larger interactional sequences. It uses series of screenshots that capture shifts of movement (Chen, 2016), and combines these analyses with the usage of musical notation where necessary (see also Streeck & Chen, in press). I used video filters on the open source program VLC to extract screenshots, then edited the transcripts in an image editor as a part of the analysis where necessary.

4.8 Discovering novel sensory experiences through navigating conflicting agendas

After Day 1 of ethnographic interviews and collecting videos of the children's everyday lives, Day 2 to Day 4 involved bringing the MMM into their homes. Once the research team had set up the cameras, and when two mats had been placed on the ground, the space was open to participants. The researchers moved aside and allowed the interactions to spontaneously unfold. Each of the parent-child dyads took some time to become acquainted with interacting with one another in the new environment. The artifacts augmented their living room floors, designating a physical area of novelty in their homes. This novelty was experienced both by the child and by the parent simultaneously, and thus both had to navigate the new environment together.

Upon entering each of the children's homes on Day 2 of the study, the researcher team set up two MMM mats in their living rooms. In Matt's and Nathan's home, the mats were placed beneath a ceilinged fan in the living room, and on top of some larger mats that they already frequently spent time on. On these large mats, Matt and Nathan would often stim, take a rest, and interact with their family members. In Chloe's home, the mats were placed in an empty area on the floor behind a couch. The floor space in this empty area was often walked upon as people traversed from the doorway to the other areas of the home but was also an area where Chloe would sometimes sit and play with her toys. When all the children first encountered the mats, they assumed a variety of initial postures. Matt and Nathan each lay down their mats, and Chloe knelt on hers, then got up and started running in

small circles on it. Although all children initially assumed different postures, they all positioned their bodies within the boundaries of just one of the mats. The initial posture of all three parents when they encountered the new floorspace was the same: the parents assumed a sitting or squatting position on the adjacent mat, facing their children.

A striking similarity occurred in all the first interactions of the dyads. Across all the dyads, the children and their parents did not at first share the same agenda when they arrived at the mats. Consistently, parents pursued the project of having their children establish hand-to-hand touch, while children pursued the project of exploring the environment in their own way. In this section, I analyze these initial interactions.

4.8.1 Matt smiles when he discovers the feature of touch-to-sound

As we set up the mats, Matt taps by himself at another part of the living room. He sits on the tiled floor, bent over, periodically hitting a plastic toy upon the hard surface in front of him. The taps resound through the living room loudly with a rich reverb. Matt is first summoned to the mat with a verbal directive from Danna, "Matt, come here". He had been tapping the floor with a plastic toy at another part of the living room but rises and walks towards Danna upon hearing her directive. Matt sits on a mat opposite her. Although he is compliant in following her instruction to 'come here', Matt does not attend to Danna at all. He sits with his back to her, then turns his body around to lie on his back as he ignores many of her invitations to interact. He rolls onto his back and props his knees up, tapping the plastic toy in his hand.

Danna invites Matt to touch her hand by extending her open palm to towards him. She rests her hand on his knee, tilting her palm forward so that its surface is exposed to Matt. This palm up open hand (PUOH) gesture (Ferré, 2012) is common among all the parents. He ignores her hand, fanning the plastic toy in his right hand. When Matt displays non-attendance to Danna, she transforms her hand gesture into light-tapping upon Matt's knees. When Matt does not react in any way observable to her, she then extends an open palm towards him. Danna's alternation between both offering an open palm, and producing light touches on Matt's body, are attempts to recruit him into participation, to perhaps spark his curiosity to interact more, and to achieve hand-to-hand contact with him.

Figure 4: Danna alternates between PUOH gesture and light touches on Matt's knees.

On the other hand, Matt pursues the interactional project of understanding the environment through his own self-exploration. Matt experiments in using his hands to touch

different surfaces—the mat he is on, his own body, and eventually his mother's—discovering for himself the sensory novelty in this environment.

Transcript 4.8.1. Matt discovers the touch-to-sound feature

1.		Matt sits up, looks at the mat, and stamps his feet lightly.
2.		Danna extends a PUOH gesture towards Matt, placing her hand close to his. Matt ignores Danna's hand and touches the mat.
3.		Danna grabs and lifts Matt's hand off the mat. Matt snatches his hand back.

4.		Danna offers her palm again. Matt pauses, then touches Danna's hand with his fingers.
5.		Matt puts his finger to his mouth, smiling, and staring at the mat.
6.		Matt leans backwards, smiles and chuckles, flapping his plastic toy.

Just prior to the interaction captured above, as Danna patted Matt's knees and produced tinkly piano sounds, Megan, a research assistant in the team, let out laughter. Matt, immediately following Megan's laughter, stops his tapping. He is perhaps alerted to the fact that there is something else special about this environment that he had previously been missing. He sits up by propping his upper torso up upon his forearms and looks down at the mat (line 1). His attention is fully directed to the mat: his gaze is on the mat, he has stopped tapping, with his body propped up. Danna stops tapping Matt's knees, and Matt stamps the heel of his left foot on mat lightly. Matt has thus begun his process of experimentation and is learning that a key feature of the mats involves making sound in some way. Danna, however, does not notice Matt's first attempts to 'figure out' the environment. In line 2, she offers her

right hand to Matt's left hand, placing her hand—palm up—very close to his. Yet again, Danna has produced an invitation with a PUOH gesture to have Matt touch her. Danna's invitation could be interpreted to be upgraded from previous invitations, in that she places her hand right in front of, and very close to Matt's hand. However, Matt ignores his mother's hand and touches the mat instead. Matt, by touching the mat now with his hand, continues with his process of experimentation. He eliminates the fact that the mat produces sound when it is touched.

In line 3, Danna prepares to produce yet another invitation. This time, Danna uses control touch and lifts Matt's hand off the mat. When Matt's hand is lifted off, he snatches his hand away from Danna's, thus removing his hand from her grasp. Danna's action interrupts Matt's careful touching of the mat, and possibly what he was thinking about during this process of experimentation. Danna, in line 4, extends her hand towards Matt again, with her palm up, and the back of her wrist on his left knee. Matt stares at Danna's hand for a few seconds. He then leans forward and touches her hand. Music sounds, and Matt's mouth opens (line 4). He produces an expression that could be interpreted as awe. He brings his hand to his mouth, and smiles, laying his torso back as he touches his mouth (line 5). Matt, still reveling in his discovery, lies back into his pillow, smiling and chuckling (line 6). Stims can occur as an expression of excitement and enjoyment, sometimes with accompanying facial expressions of smiles and laughter (Chen, 2016, 2022), and the same happens with Matt in line 6 as he flaps his plastic toy with both hands, lightly and quickly.

Matt has to, in his own way, perform a series of actions that would lead him to his discovery. Matt only discovers and appreciates the novel touch-to-sound feature/experience when he has time to explore and experiment. As he carries out his process of touching different surfaces, Danna continues to pursue her agenda of having Matt touch her hand. Matt continuously asserts interactional effort to ignore his mother's invitations (line 2), and to outrightly reject her control touch (line 3). It is only when he has sufficiently explored the environment that Matt comes to discover and appreciate the key design principle: mapping interpersonal touch to sound (line 4). He has to navigate an interaction that has a strong pull towards Danna's project of touching her open palm. He does, eventually, but only when the action contributes to his project of 'figuring out' the feature of the environment.

4.8.2   Nathan attempts to share his sensory experience with mother and researcher

Nathan does not, at least from current analyses of the data, go through the same 'figuring out' process as did Matt, and as the next sub-section discusses, Chloe. The interpersonal touch-to-digital sound feature of the mat is not a sensory experience that Nathan is drawn to during his first encounter with the mats. Instead, Nathan haptically explores all the items the researchers bring into the space: cameras, bags, keychains on bags, zippers, hairties. He feels the edges of the smooth goPro cameras, hugs the bags, twiddles the keychains on them, and runs one of our team member's hairties between his fingers and thumbs. His attention flits from one object to another as he walks around his living room, which is now filled with objects that are unusual to him.

When we lay out the longer mats, Nathan immediately lies face down on one, his body aligning with the length of the mat. He swings his legs from left to right, lies down on his side, and assumes a variety of postural configurations that he would otherwise assume in

everyday life (see Streeck, 2018). Ellie sits on the mat opposite him and attempts to recruit him into participation with her. She alternates between extending PUOH gestures and lightly tapping Nathan on his leg (see Figure 4.2. below).

Figure 5. Ellie alternates between PUOH gesture and light touches on Nathan's leg
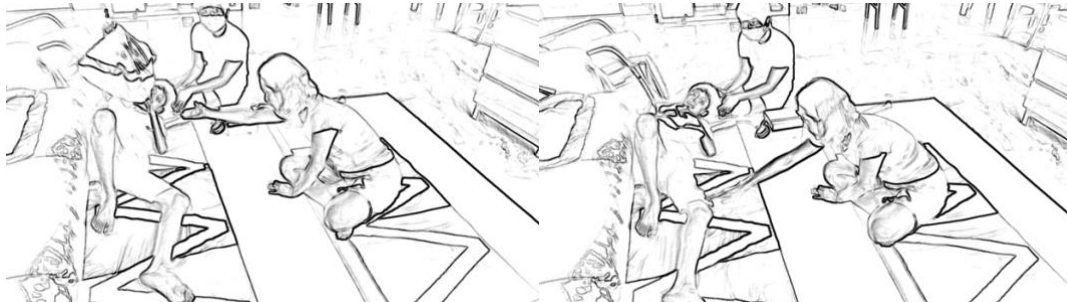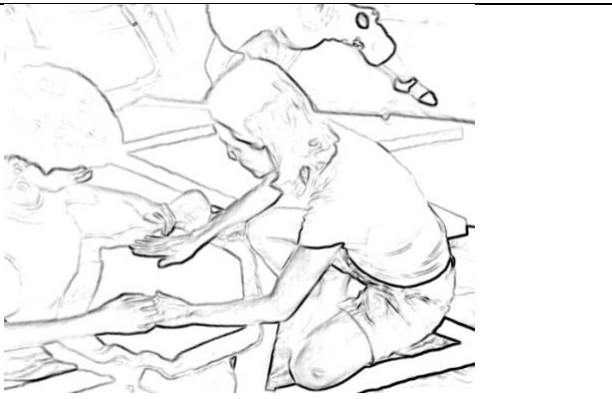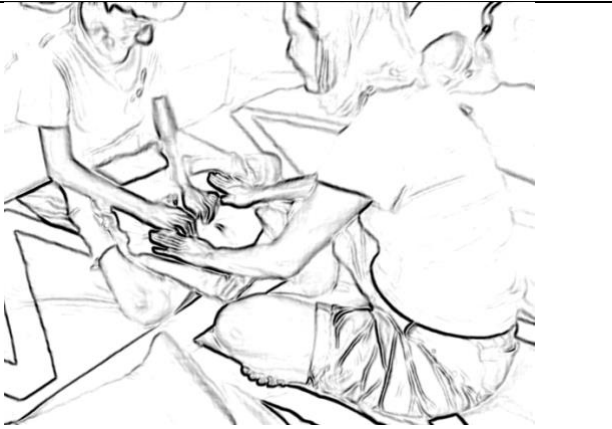
Upon his first encounter with the smaller mats, Nathan begins interacting with them in a way that is not expected by the research team. Nathan is immediately drawn to the crinkly texture of the velostat that covers most of the smaller mats. Instead of sitting or standing on the mats, Nathan picks one up and starts scrunching it. The velostat, which is a thin and flexible sheet of rubber, makes a light crinkly sound when scrunched. Nathan places a mat on his lap and repetitively scrunches it in both his hands (figure 1), head bent as he looks down at the activity in his lap.

Through picking these mats up, and interacting with them intimately, Nathan forms a sensorial relationship with these novel materials in a way that is enjoyable for him. He continues to seek out this form of interaction with the mats throughout his first length of time with it, and for subsequent days of the study. Nathan scrunches the velostat, bringing the material into his hands by pulling it into his palm with his fingers, then releases the material. He again makes a fist with the velostat in his grip, then lets the material go. The mat has now been incorporated into a new repetitive practice. Ellie, in the meantime, attempts to recruit Nathan into interpersonal touch-to-digital sound interaction through alternating between offering her open palm and lightly touching his thighs.

Transcript 4.8.2. Nathan attempts to share his pleasurable sensory practice with Ellie

7.		Nathan comes into face-to-face formation opposite Ellie, adjusting the mat on his lap. Ellie holds a 'high-ten' gesture, accompanied sustained eye gaze with him.

8.		Nathan grabs Ellie's wrists.
9.		Nathan places Ellie's hands, palm down, on the center of the mat. He removes his hands from holding hers. Ellie starts patting and squeezing Nathan's legs instead.
10.		Nathan places both hands in the middle of the mat and scrunches the mat twice.
11.		Nathan moves his hands aside, providing mat space for Ellie's hands. Ellie starts patting and squeezing his legs.

In the transcript above, Nathan attempts to share his new sensory practice with Ellie. Specifically, Nathan attempts to have Ellie experience the scrunching: he tries to *teach* Ellie to scrunch in his style. Just prior to the start of the interaction, Ellie produces multiple

attempts to recruit Nathan into touching her hand. Just like Danna, and as discussed in the next section, Lin, Ellie had tried to recruit Nathan's attention by offering her open palm and alternating this gesture with light touches on Nathan's leg. In the interaction featured above, Nathan, who was at first lying down on the mat, moves into a cross-legged sitting position in face-to-face formation with Ellie. In line 1, Nathan adjusts the mat on his lap, while Ellie holds a high-ten gesture, with sustained eye gaze on Nathan. Once he has sufficiently adjusted the mats, Nathan grabs Ellie's wrists (line 2) and brings them down onto the mat. In line 3, Nathan places Ellie's hands, palm down, on the center of the mat. Once they are firmly on the mat, he removes his hands from holding hers, which allows her to move freely without his control touch. In line 4, Nathan demonstrates for Ellie how the scrunching should take place. He places both hands in the middle of the mat and scrunches it. He then moves his hands aside in line 5, providing mat space for Ellie's hands. Ellie starts patting and squeezing Nathan's legs instead.

Ellie and Nathan share a relationship in which their bodies have a history and routinized ways of interacting with one another through touch. Although Nathan attempts to share with his mother a new way of experiencing the mats, Ellie brings onto the mat her usual touch practices with Nathan, which often involves deep pressure massages. She assumes that Nathan's use of control touch on her wrists is a request for a massage, and not an invitation to learn. Nathan, on the other hand, produces many actions that provide opportunities for Ellie to learn. Firstly, in line 2, he grabs Ellie's wrists, not her hands. Nathan makes clear to Ellie that his action is not one that joins her interactional project. He is careful to not provide any uptake to her invitation to engage with her open palm. Secondly, in line 3, Nathan brings Ellie's hands down onto the center of the mat. Nathan is closely attuned to Ellie: he lifts his hands once hers touch the mat, leaving her sufficient space and agency in moving her hands. Thirdly, when Ellie mistakenly massages Nathan's legs instead, demonstrates for her how the scrunching should be done. He stops Ellie's movement by putting his hands in the middle of the mat, thus obstructing her hands. He then demonstrates by scrunching the mat just two times. Nathan finally moves his hands aside to let her scrunch.

Ellie never recognizes Nathan's attempts to teach her. Instead, she continues to massage him. Nathan, however, is persistent. He continues to produce the same 'teaching' actions as the interaction continues, making them more exaggerated so that Ellie would notice them. When Ellie continues to massage Nathan, he attempts a different strategy. He gets up from the longer mats, taking the small mat with him. He sits beside me and begins scrunching. Sometime before the interaction above, I had noticed Nathan's scrunching and had told Ellie that Nathan enjoyed the practice. Nathan even brings the mats to me a few times, but I am busy fixing a connection in the circuit. I do not notice Nathan's attempts to recruit me into noticing his scrunching, or to possibly alert his mother to them again on his behalf.

4.8.3 Chloe asserts the accomplishment of her own activities

As the research team sets up the mats, Chloe runs back and forth. She kneels on the mats, and her mother, Lin, joins her on an opposite mat. Lin produces a series of light touches on Chloe's arms and legs, but Chloe does not react. Chloe makes her way towards her AAC device, and types in "I want bubbles". She makes a request for a different activity

than what her mother, and the research team, are pursuing. I had told Lin earlier that if Chloe did not want to participate, she did not have to. Lin, however, explains that Chloe had already played with bubbles earlier, and she had already taken a bath. Preferring a cleaner, indoor activity, she continues to attempt recruiting Chloe into touch-based interaction with her on the mats.

Like Nathan, Chloe is curious about many of the items brought in by the researchers. She is especially drawn to the cameras. We had already brought cameras into their home during our last time together, and Chloe had displayed less interest in the cameras then. Chloe's living room space is also being drastically transformed by the mats, and she runs back and forth from the mats, and away, then back again. Eventually, Lin successfully recruits Chloe into interaction with her.

Transcript 4.8.3.1. Chloe undergoes the discovery process

1.		Chloe experiences being touched on her leg by her mother, Lin.
2.		When Lin moves her hands into the high-ten gesture, Chloe touches her own leg. No sound plays.
3.		Chloe touches Lin's hands, and sound plays. Chloe produces a series of light pats on Lin's hands.

Just prior to the transcript above, Chloe's attention was focused on some metal utensils and other toys Lin had brought onto the mat. Lin sits opposite her on another mat, and begins to produce light touches on Chloe's knees (line 1). Chloe gazes down at them as she experiences the touching. Lin then moves her hands into a high-ten gesture, inviting Chloe's touch upon them (line 2). Chloe touches her own thighs with both hands, but no

sound plays. Chloe then touches Lin's hands, and a string of tinkly piano sounds play (line 3). Chloe produces a series of light pats on Lin's hands. As with Matt, she progresses through the different stages of discovery. Interestingly, Chloe progresses through these stages on multiple occasions through her first day with the mats, and twice in the second day. After the interaction above, Chloe's attention returns once more to the cameras. Lin once again recruits Chloe's attention, and the following interaction ensues.

Transcript 4.8.3.2. Chloe establishes boundaries with Lin

1.		Lin extends a PUOH gesture towards Chloe. She then switches to producing light taps on Chloe's thighs.
2.		Once Lin retracts her hands, Chloe touches her own leg with her finger.
3.		Lin grabs Chloe's hand and moves it around.

| 4. | | Chloe retracts her hand and stares at Lin. |
| 5. | | Chloe attends to the camera. |

In the transcript above, Lin extends an open palm towards Chloe (line 1). Chloe looks at it but does not touch her mother's palm. Lin then switches to producing light taps on Chloe's thighs (line 1). Once Lin retracts her hands, Chloe begins to touch her thigh (line 2). Lin continues to extend her open palm towards Chloe. This time around, Lin does not wait for Chloe and grabs Chloe's hand in line 3. Chloe retracts her hand, and stares at her mother for a moment, who continues to extend an open palm gesture (line 4). Chloe turns her attention to the camera again.

Like the other two mothers in this study, Lin uses a select few gestures to recruit Chloe's touch. Lin alternates between two gestures: a palm up open hand (PUOH) gesture, and light touches upon Chloe's thigh. Chloe, like Nathan and Matt, ignores the invitation to touch her mothers' open palm. She attends to her mother's light touches on her thigh: she visibly shifts her eye gaze to look at Lin's tapping. Eventually, she begins the 'figuring out' process by touching her own thigh a few times, and no sound plays. Based on the 'figuring out' pattern explained before, Chloe would presumably touch Lin as a next step, but her movements are interrupted by Lin's grabbing. Chloe immediately pulls her hand back: she does not allow her mother to control her movement. Chloe also stares at her mother, displaying her stance against the action Lin had just produced. Chloe then turns her attention to the camera. It is only later, when Lin once again produces the high-ten gesture in combination with playful tickles (a game they would often play on other occasions), that Chloe begins to interact with Lin on the mat again.

4.8.4   Discussion

Some similarities occur in the initial interactions of all dyads in this study. Upon arriving to the mats, they would sit cross-legged, ensuring they are facing the direction of their child. All the parents are clearly oriented to recruiting hand-to-hand contact with their children. All three parents clearly pursued the same interactional project when they first

navigated social interaction on the MMM. All three parents alternate between the PUOH gesture, and light touches upon the leg as some of their first social actions on the mat. When children did not respond to their parents' open palms, the parents alternated the PUOH gesture with the production of light touches on various parts of their children's bodies, such as on their shins or thighs, or forearms. These light, playful touches matched the texture of the sound playing from the MMM, which were tinkly piano sounds. The light touches could have been produced to keep some interaction going between parent and child, as an attempt to pique the child's interest in touching their mother back. The light touches could also have been the parent's attempt to explore the environment themselves, which Lin verbally explicated during her session with "I'm so curious" as she touched her child. Parents would again extend another PUOH gesture, then return to the light touches when their invitation received no uptake from the child.

A PUOH gesture heavily constrains the action possibilities of the child in several ways. The child is expected to touch their parent—on a very specific area of the body (fingers and palm of the parent's hand)—for interaction to happen. The child is therefore discouraged from exploring touch-based interaction with other parts of the body and exploring the environment in their own way. Secondly, touching a parent's open palm presents a possible risk for control touch, wherein the parent's fingers can enclose themselves around the hand or wrist of the child. All the children rarely produce an uptake to the PUOH invitation, largely ignoring their parents' hands when the invitation presents itself. Although Matt does touch Danna's hand eventually, all his touches are produced with only his fingers overlapping with Danna's fingers. He stays away from the palm of his mother.

The children on the other hand take on a variety of postural configurations on the mats, whether bringing their tapping tools, and leaning back on pillows while maintaining contact with the mat (Matt), lying down lengthwise on the mat (Nathan), or else kneeling or sitting cross-legged on the mat (Nathan and Chloe). All three children find their own ways to discover sensory novelty in the environment. Matt and Chloe undergo the same process, discovering the touch-to-sound feature of the mat. They navigate conflicting agendas with their parents in order to pursue this process.

Discovery process of interpersonal touch to sound:
1. Child and parent eventually arrive on MMM floormats
2. Child realizes there is something novel about the environment
3. Child produces 'test' touch actions on the mat, and on themselves
4. Child touches parent

Through the above learning process, the children restructured their worldview of the environment (Nishizaka, 2009) by performing test actions on the artifacts, and coming to a new understanding about core features of them. After this discovery process, Matt and Chloe perform actions that display sensitivity to their new achieved structure (see also Nishizaka, 2009): in their own time they return to the touch-to-sound interaction and experiment with the sound even further, during later interactional sequences.

Although Nathan does not undergo the same discovery process, he finds his own pleasurable sensory experience with the artifacts we have brought. Nathan scrunches the

mats, which produces crinkly sounds, but is also a pleasurable tactile experience. He attempts to teach this practice Ellie, but unfortunately his actions are misinterpreted by her and unnoticed by me. Nevertheless, all the children demonstrate great autonomy in exploring the artifacts themselves, discovering elements of it they enjoy interacting with. They also navigate a strong pull into their parents' interactional project, while pursuing their own.

4.9   Co-creating a pleasurable sensory experience together

Each of the parents, as demonstrated in the previous section, privilege interacting with their children's hands in some way. Although their invitations to engage in touch sometimes involve taking objects away from the children, performing control touch actions upon the children's hands, or misinterpreting the action trajectories of the children, parents eventually find creative ways to come 'in touch' with their children: by facilitating the enactment of a pleasurable sensory experience for the child. Interpersonal touch, being a core design feature of the augmented environment, eventually orients all the parents in the study towards objects and surfaces their children are interacting with by hand. They bring objects onto the mat and use them in creative ways with their children. Sustained, mutually elaborative interactions often occur when parents attend to the stimming of their children, whether through engaging in tapping, swinging, or playing the same piece of music together.

All three autistic children produced a variety of stims. These stims were all mentioned in the ethnographic interviews, and most were observed in the videos collected. Table 1 below describes the different stims of the autistic children. These stims are movement signatures—sustained postures and cycles of movement that are a common occurrence for a person (see also Streeck & Chen, in press). Each of the children had different movement signatures, and always produced these movements by themselves. Matt would take a hard object, like a plastic toy, and use it to tap repetitively on the ground. Nathan would swing, and would fiddle with items he would bring onto the swing. Chloe would play "Ode to Joy" on her phone again and again.

Table 3: Autistic participants' frequent stims

Name	Stims
Matt	Tapping
	Rubbing certain fabric with hands
Nathan	Swinging, shaking noisy items, rocking
	Swaying legs, throwing items on floor
Chloe	Playing "Ode to Joy" on phone (music apps, youtube)
	Swaying legs, playing some youtube songs

In this section, I analyze and discuss these stims as they occurred as a co-constructed practice in the unfolding interactions of parents and their children. In each of the following three sub-sections, I analyze and discuss some of the most sustained, mutually elaborative interactions that occur between each child and their parent. Each sub-section will introduce the larger context within which the interaction began, provide an impression of the overall

structure of the interaction, and zoom in to a notable segment of the interaction. The section ends with a closing discussion.

4.9.1 Tapping together

The most sustained interactions between Matt and his mother, Danna, occurred when the researchers moved the mats to the couch, a physical area within which the dyad frequently interacted with one another. In their everyday lives, Matt and Danna would often sit side-by-side on the couch in the afternoons, where they would read books, write, and watch television together. During Day 2, and after several interactions of navigating his mother's control touch over the movement of his hands, Matt left the mats and headed to another part of the living room to tap by himself. He ignored his mother's multiple verbal invitations to return to the mats. As an attempt to facilitate more interaction between Danna and Matt, the researchers moved the mats to the couch, so that both participants could sit on the couch with their bare feet on the mats.

Danna asked the researchers how the mat worked, which then allowed her to realize that music could also be produced by being haptically linked to Matt through a conductive object. Knowing that Matt enjoys tapping, Danna then brought some metal utensils—four spoons—onto the couch with her. She sat on the couch with her feet touching one mat, inviting Matt to sit down beside her.

Matt takes up Danna's offer to tap upon her spoon. Once he begins tapping, the spoon gathers momentum by springing up and down with some buoyancy. With each hit, the metal spoons emit a clanging sound that is *accented* with 2-3 musical notes from the floormats. Matt's experience of hitting Danna's spoon with his spoon thus provides haptic feedback up his arm, but also becomes a different sonic experience than the usual items he taps. The taps are more percussive: the clanging is crisp and resonant, and the musical notes made the impact of Matt's taps on Danna's spoons more prominent. Each time he taps on Danna's spoons, the musical notes are different, starting from around G flat.

Transcript 4.9.1. Beginning of a turn-taking sequence

Figure 1. Danna offers her spoon as a surface for Matt to tap upon. Matt taps her spoon with his left hand.
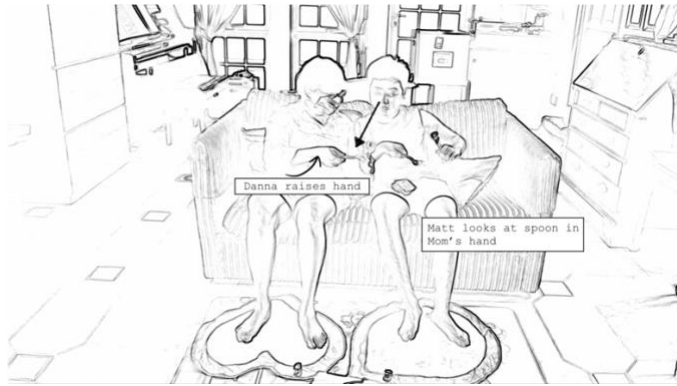
Figure 2. Danna raises her other hand towards Matt's right hand. Matt looks at the spoon in her hand.

Figure 3. Matt begins to tap Danna's spoon with his right hand, pausing the tapping with his left hand.

When Matt joins his mother (Danna) on the couch, she offers him two spoons. Matt and Danna hold a spoon in each hand, and Danna then slips her left hand through the gap between his forearm and the side of his body. With their forearms intertwined, Danna raises the spoon in her left hand towards the spoon in Matt's left hand. Danna's action offers her spoon as a surface for Matt to tap upon. Unlike the PUOH gesture, which poses the possibility that Danna close her fingers around Matt's spoon, Danna's spoon is a material surface that cannot perform control touch upon Matt's spoon. Matt takes up the offer, repetitively using the spoon in his left hand to hit her spoon (Figure 1), creating a loud 'clang' each time they hit utensils. Tinkly piano sounds also play each time Matt's and Danna's utensils touch one another. After a few taps, Danna raises her right hand towards Matt's right hand (Figure 2). Matt's eye gaze shifts from his left hand to his right hand, and for a moment, he glances at the spoon in his mother's hand. Matt begins to tap his mother's spoon with his right hand, pausing the tapping in his left hand (Figure 3). After a few cycles of tapping upon Danna's spoon, Matt encounters another invitation from Danna to tap upon her left spoon with his left hand. Matt responds by tapping, and thus, Matt enters into a repetitive cycle that is different from his usual tapping. He alternates between tapping with his left hand, and tapping with his right hand, alternating between the taps even during later cycles, without Danna's invitations. These repetitive cycles, involving alternations between tapping with his right hand, then his left, are also simultaneously felt by Danna as her spoons

are tapped upon. She ensures that the spoons are close enough to Matt's hands so that he can continue tapping on them with ease.

New repetitive cycles are established conjointly by both mother and child. Danna facilitates the enaction of Matt's stims, and together, the stims are transformed in two ways. In the first, Matt's stims are no longer produced by just one hand, but at this point involve an alternation between both his hands. In the second, Matt's stims now *require* the spoons of his mother in order to be produced with haptic feedback to his hand, and with the loud sounds that always occur with his taps. Through fine attunement to the facilitation of Matt's stims, Danna co-creates a new sensory experience with Matt, one that allows him to continue his tapping but in a way that involves her.

4.9.2 Swinging together

As with Matt and Danna, Nathan's and Ellie's most sustained interactions also involved the transformation of Nathan's stim. Nathan, as observed during the researcher team's first visit and as reported by his mother, would often sit in his swing and rock himself. The swing itself was in a large, designated area, occupying much of the physical space by the family's front door. During our third visit to Nathan's home, Nathan left the living room floor space and spent some time on the swing. The research team suggested putting the mat on the swing and another on the ground. We waited for Nathan's swings to stop before we slowly approached him and gently placed a mat under him. We placed another mat on the ground right in front of the swing. The placement of the mats on the swing and the floor established a spot for Ellie to stand on and another for Nathan to continue sitting on. Nathan had brought a hairtie onto the swing with him: it was the hairtie of one of the research assistants. He twiddled with it as he swung.

Ellie begins to recruit Nathan into interaction with her. She stands on the mat, extending her right palm towards Nathan. When Nathan does not respond to the open palm invitation, Ellie gently holds his fingers, and begins to pull and push on them. Her pushing and pulling rocks Nathan back and forth, but not for long. Nathan removes his fingers from her grip and turns his body away from her. Rachel then makes a comment, stating "you touch feet also can", meaning that music would play if both touched feet. Nathan begins to produce slight kicks with his feet as he swings towards Ellie, his toes creating piano sounds as they touch the front of his mother's ankles. As demonstrated in the previous section, Nathan does not produce any uptake to the open palm invitation from his mother. Nathan also rejects his mother's control over the movement of the swing, removing his fingers from her grip and turning away from her. He only begins to initiate contact with his mother when she no longer is in control of the movement of his swing, and when he has full agency in connecting with her through the leg kicks.

After a few swing cycles, Ellie extends her hand, placing it close to Nathan's hands. Nathan passes Ellie the hairtie, and she puts it up her arm. The following interaction ensues.

Transcript 4.9.2.1. Nathan reaches for hairtie, letting his hands trail down Ellie's forearm

Figure 1. Nathan reaches for hairtie on Ellie's arm as he swings forward.
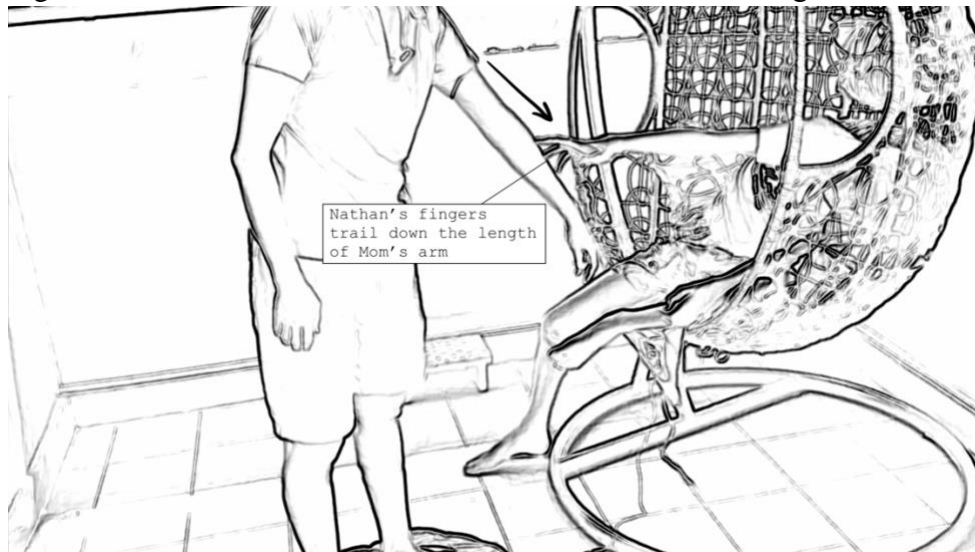
Figure 2. Nathan misses the hairtie, but allows his fingers to trail down the length of Ellie's arm

      As Nathan swings forward, he reaches his right hand out towards the hairtie on Ellie's arm. He does not lean forward but remains nestled against the soft pillows on the swing. Nathan allows the momentum of the swing to carry his body forward, making contact with Ellie's arm lightly, but not trying too hard to grab the hairtie (Figure 5.2.1.). He trails the tip of his fingers down the length of Ellie's arm as he swings backwards (Figure 5.2.2.). The mat produces a series of piano sounds that gently trail off when he loses touch with Ellie's skin as the swing moves backwards. Several cycles of this interaction occur, with Nathan swinging forward and reaching for the hairtie. During these cycles he misses grabbing the hairtie, but maintains the stretch of his hand, keeping in contact with Ellie's arm for longer until he swings out of reach.

Transcript 4.9.2.2. Nathan grabs hairtie, and the interaction evolves

Nathan
grabs
hairtie
on Mom's
arm

Figure 3. Nathan reaches out and manages to grab the hairtie

Nathan's
grasp
brings
hairtie
down Mom's
wrist

Figure 4. Nathan maintains a grip on the hairtie, and brings it down to Ellie's wrist as he swings backwards and away from her

Nathan eventually grabs the hairtie on his mother's arm. He does so by putting his thumb under the elastic and curling his index finger around the material (Figure 3). As he swings backwards, Nathan maintains his hold on the hairtie, such that it is brought down to Ellie's wrist (Figure 4). She points her fingers downwards, preventing the hairtie from leaving her wrist as Nathan swings backwards. With both Ellie and Nathan now haptically connected by the hairtie, Nathan's swinging movement is further transformed. As Nathan swings back and forth, he is now pulled back towards Ellie through the tension in the hairtie. Nathan makes hand-to-hand contact with Ellie each time he swings forwards, and the mat produces a quick series of piano sounds each time this happens. The periodicity of Nathan's swings is thus sonically amplified, with sound produced simultaneously with the apex of his swings. Nathan laminates further action onto their interaction in later repetitive cycles, continuing to touch Ellie's hand, but also touching her ankle through slight kicks of his leg.

Towards the end of their interaction, which consists of many repetitive cycles, Nathan takes the mat from under him, and begins to crinkle it as he continues to hold onto the hairtie and touch his mother's hand.

Nathan's interactions with his mother involve repetitive cycles of swinging back and forth. Through these cycles, the interaction gradually evolves, with Ellie facilitating the momentum of the swinging. This interaction is sustained and mutually elaborative because Ellie does not control the momentum of Nathan's swings. She allows him to be in control of his swinging, her social actions serving only to auditorily and haptically enhance his ongoing repetitive movement. Nathan himself participates in the interaction, laminating action upon action in a way that would both continue their interaction and elevate his unfolding sensory experience. He touches his mother as he swings, then maintains a hold on the hairtie which allows him to swing towards her quicker because of the tension in the elastic. He then laminates further action upon the interaction, kicking her legs and adding more musical sounds. Eventually, he even incorporates crinkling—a pleasurable interaction with the velostat— into his ongoing sensory experience. Nathan transforms his swinging experience accumulatively, laminating action upon action that would serve in interest of amplifying his sensory experience.

4.9.3 "Ode-ing" together

Chloe and her mother, Lin, also engage in multiple co-constructed repetitive cycles, as did the other two dyads. Chloe had a strong preference for a particularly musical stim; she would often play the song "Ode to Joy" again and again on a piano app on her mother's phone. Noting this repetitive practice, "Ode to Joy" was set up in the Magical Musical Mat, such that every finger movement would trigger each consequent note of the song. Three different timbres were programmed into the mat, so that different degrees of skin-to-skin contact allowed for different types of sounds to play.

Lin successfully recruits Chloe into interaction with her by sitting on one mat, inviting her to sit on the other. Lin extends her fingers towards Chloe, not with her palm up, but rather with her palm down. She says "piano" with a sing-song prosody, and Chloe begins to play on her mother's hands as if her mother were a piano. Round upon round of playing "Ode to Joy", Chloe explores a variety of touches upon her mother's hand, keeping a consistent tempo to her playing, but changing only the way in which she touches her mother. The following transcript details Chloe's production of "Ode to Joy" over two cycles of the song, and the unfolding of her varied, exploratory touching of Lin's hands.

Transcript 4.9.3. Chloe plays two cycles of "Ode to Joy" on her mother's hands
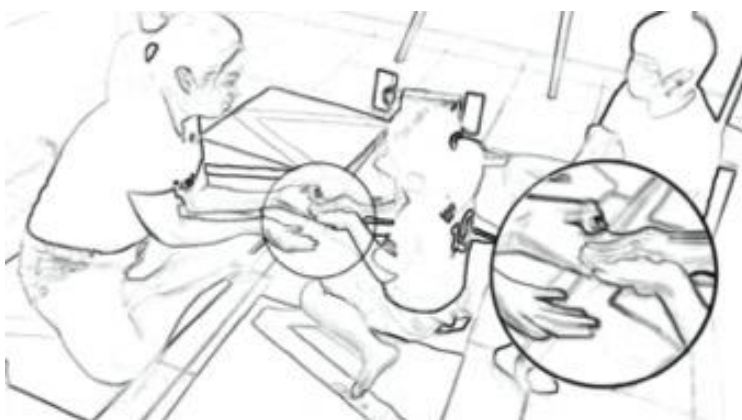
Figure 1. Chloe uses all ten fingers to pat the surface of Lin's fingers

Figure 2. Chloe raises her hands and begins to play with her middle and index fingers

Figure 3. Chloe plays only with the index finger of her left hand

Figure 4. Chloe plays on the tip of Lin's fingers

Figure 5. Chloe touches the tips of Lin's fingers by curling and flicking finger, changing the timbre of the sound produced

As Chloe plays through cycles of "Ode to Joy", no cycle is played in the same way. Chloe varies the way in which her hands interact with Lin's, performing a range of touch-based gestures upon her mother's fingers. As seen in transcript 1, over the course of cycle 1 of "Ode to Joy", Chloe uses all 10 fingers to gently pat the fingers of her mother (Figure 1). The mat plays "Ode to Joy", with a slightly sustained note each time. During the second half of cycle 1, Chloe changes the shape of her hands slightly. She holds her wrists up, touching Lin's hands with only the very tips of her index and middle fingers (Figure 2). Chloe uses this hand shape for just a few notes of the piece before trying yet another hand position. She lowers her right hand and plays upon Lin's fingers with just the tip of her left hand's index finger (Figure 3). The decrease in skin contact with Lin results in two notes of "Ode to Joy" played with *staccato*: notes of very short length. Without missing a beat, Chloe plays the last two notes of cycle 1 with the index fingers of *both* hands, such that the song ends off with two more sustained notes. Chloe thus ends off "Ode to Joy" with a timbral change, that provides a more complete close to cycle 1.

Chloe has, by the end of cycle 1, produced three different touch-based gestures upon Lin's hand, with each gesture flowing into the other gradually. From Figure 1 to Figure 2,

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Chloe gradually lifts her fingers, keeping just her index fingers down. From Figure 2 to Figure 3, Chloe simply lowers her right hand, and continues the momentum of playing the piece with her left hand. She raises her right hand on the last two notes of cycle 1, ending off "Ode to Joy" with two more sustained notes. Chloe continues with the momentum of the music without missing a beat, performing a variety of gestures that change the quality of the sound playing from the mat.

In cycle 2, Chloe returns to the gesture depicted in Figure 3. Her use of one finger does not trigger any sound changes, and Chloe continues with this gesture for most of cycle 2. Towards the end of cycle 2, Chloe makes a change to her gesture production. She switches from using her left hand to using her right, touching the tip of Lin's fingers with the tip of her fingers. The decreased skin contact with Lin (from two fingers to the tip of one finger) begins to trigger a staccato sound in the mat after two notes with this gesture. To decrease even further her skin contact with Lin's finger, Chloe begins to touch the tips of Lin's fingers by curling and flicking her index finger towards her palm. Consistently, she continues with the staccato sound for the next cycle, then continues to produce more variation to her touch-based gestures over the course of the next few cycles.

4.9.4   Discussion

Diverse as these interactive stimming practices are across the dyads, all of the above interactions share some similar characteristics. All parents become gradually attuned to the sensory practices of their children, finding creative ways to enter new repetitive cycles together, laminating action upon action, with the cycles evolving over time. For Matt and Nathan, other artifacts, such as spoons and a hairtie, become central in mediating their interaction.

The stimming practice of the children, different as they are, all become *substrates* for interactional reuse and transformation. A substrate is a way to indicate an utterance, or any other public source that serves as a point of departure for operations used to build subsequent action (C. Goodwin, 2018; p. 40). The substrate—stimming movements, in this case—thus becomes a mutually agreeable focus of transformative operations for the individual and their interactant.

With each cycle of the stims—each tap, each swing, each finger movement— sonically amplified by touch with their parents, sound becomes a modality that the children can play with. The periodicity of their movement is amplified with musical sounds, bringing into activity the creation of a new sensory experience, allowing the children to become aware of the presence of their stims. Their stim movements change, become more varied and expressive, and they embellish the periodicity of their repetitive behaviors. Nathan creates rhythmic variations of his own by touching his mother's forearm and hand, followed by the peppering of little kicks upon Ellie's shin. Chloe plays with a variety of timbral changes upon her mother's hands, matching them to the musical structure of "Ode to Joy". Matt maintains the periodicity of his taps upon Danna's spoon but varies the weight of each tap. These variations in weight change the pitches produced by the floormats. When asked questions about the session and the MMM, Matt responded on his alphabet board by thanking the research team for the "beautiful sounds" and noted that the "bass_marimba" was his favorite musical palette.

By coming into touch with one another, the solitary stimming practices of the autistic children require the participation of the other. These stimming movements change in how they are being produced, because they become part of a social ecology. In Matt's case, from his usual practice of tapping with just his right hand, he comes to alternate between tapping with his left and his right hands. In other parts of his tapping interactions, he also varies the height of his arm, dynamically changing the volume of the taps he produces, but also varying the assertion of his spoon hitting upon Danna's. For Nathan, the push and pull of his swing become part of a game involving reaching for the hairtie on Ellie's arm. When he eventually grabs it, and pulls it downwards, his swinging movement itself becomes incorporated into the tension of the hairtie that is being grasped by both. Much like a pendulum, Nathan swings back and forth, with the swing cycles evolving over time, no swing ever the same. Lastly, Lin's hands are transformed into the keys of a piano (or perhaps a touch-based synthesizer) that Chloe can play her favorite song upon in a musically expressive manner. The parents Danna, Ellie, and Lin, by coming into intercorporeal attunement with their children's stims, become a central part of the stimming practice, and also get to experience its motion upon their own bodies.

The interactional cycles between parent and child can be likened to the cultural practice of free improvisation. As Duby (2020) posits, free improvisation, in which participants interact in an unscripted manner, is 'at the edge of chaos' (p. 8) by operating in a state that is far from equilibrium. The process of improvising together requires a dynamical coherence between individuals through a blend of stability and active flexibility (Laroche et al., 2014). Each dyad came to create and kept creating repeated cycles that were stable and predictable. Yet, no two cycles were ever the same, and anything that was repetitive was not for long. As time went on, each of the dyads' interactions evolved co-operatively (C. Goodwin, 2018), where material from a previous cycle became material for the next, in cycles of reuse and transformation.

4.10   Conclusion

The interactions of the non-speaking autistic child and their speaking non-autistic parents serve as a fundamental context for the study of intercorporeal attunement. There is huge potential in embracing communication beyond oral-acoustic referential language, forefronting touch, music, and stimming as a way to be, and as a way to be with others. In this study, novel artifacts—floormats that mapped interpersonal touch to sound—were brought into the homes of autistic children as an effort to intervene not on the autistic child, but on their interactions with speaking others by augmenting their environment. How do these differently disposed social actors achieve mutual understanding?

The most foundational level of agency is to be presumed as performing actions that are perceived by others as socially relevant. In this study, three different non-speaking autistic children and their respective parents navigate interaction together in an augmented living room space and learn how to interact with each other in a novel situation. Upon encountering these new artifacts, parents and children alike demonstrate curiosity. Nevertheless, their initial interactions are built upon their bodies' relationship history. Parents recruit their children through extending an open palm or displaying both palms in a 'high-ten' gesture as an attempt to have their children come into hand-to-hand contact. They also

alternate these invitations with light touches on their children's legs, perhaps as an attempt to draw their children's interest in the touch-to-sound interaction. The children, on the other hand, do not take up their parents' invitation. Instead, they pursue their own project of 'figuring out' or discovering the novelty in the environment *themselves*. Children are assertive in pursuing their own projects, despite the many invitations to join their parents' interactional projects. Nathan even makes several attempts to teach his mother his way of interacting with the mats.

Although each of the parent-child dyads continues to navigate different interactional projects throughout the study, eventually, the design feature of interpersonal touch orients parents towards their children's stimming practices. The most sustained interactions involve parents attuning to the stims of their children by facilitating their expressiveness. As a result, the stims become a substrate within an interactional practice haptically felt by and co-operated upon by both interactants.

The children's stims change in three ways. Firstly, they each explore a variety of movements that are more diverse than the periodic, solitary stims they usually produce. Secondly, the music sonically amplifies their stims, which additionally allows them to interact with musical structure. Thirdly, the stims are transformed from solitary behavior to co-constructed action: children and parents share in creating a sensory experience that is grounded in the child's enjoyable practices. Parents and their children are jointly engaged, building off each other's actions gradually in sophisticated ways.

Cultural tools are embodiments of the function and meaning of sociocultural practices and are significant in the process of development, when learners actively reconstruct the tool's normative meaning and function, through acting upon and with them (Saxe, 1991). This study features an interactive environment that was an effort to bridge between two diverse communicators. Firstly, bodies were brought together in close proximity, wherein intercorporeal attunement through touch—one of the most foundational ways to connect with another—was brought to the fore. Secondly, music created a cultural bridge, being a common medium of enjoyment for both parent and child. The MMM augments not the more vulnerable communicator, but rather their environment, so that their interactions with others could be more inclusive. Through forefronting interpersonal touch and music, the MMM frees interlocutors from the instinct to maintain verbal conversation, temporarily suspending the rules of normative interaction. The MMM creates a situation where coming into intimate, multisensorial interaction is sanctioned and encouraged.

But the MMM is merely a trick. In the folk tale of the *stone soup*, a magical stone is placed in boiling water for the creation of delicious soup. As time continues, additional ingredients—vegetables, meat, and other condiments—are added to the soup gradually. When the soup is done, the stone is taken out, and the nourishing food is enjoyed. In a similar way, the MMM became the stone soup of each home, where additional objects were brought into the space, and interaction occurred accumulatively and gradually. These interactions are available all the time, with or without the mat, should participants wish to engage as such, and should parents notice and recognize the social actions of their children.

Some theoretical, practical, and methodological implications are borne from this study. Firstly, that stimming can occur between autistic children and their parents invites a relabeling of the diagnostic criterion for autism, which characterizes solitary stimming and a

'deficit in social communication' as two independent hallmarks of Autism. This study, and more broadly the phenomenon of interactive stimming, pulls the two diagnostic attributes of Autism into question. Secondly, this study has implications for how parents, therapists, and educators can approach, understand, and support communication with non-speaking autistic children. The study proposes that inclusive education with neurodiverse individuals begins by embracing and enhancing their diverse interactional practices, so that their multisensorial social actions can be noticed and recognized as such. Thirdly, the analysis expands upon research on embodied interaction by closely examining the co-creation of enjoyable sensory experiences for a population that is especially attuned to the sensory properties of people and artifacts. Through the process of careful transcription, otherwise unnoticeable social actions were made visible. Lastly, there is great importance in examining the researcher's participant roles during data collection, especially when research involves bringing artifacts into the environment that are meant to enact some change. Given that the researcher is in a position of power when working with disabled individuals, how do we navigate work with a vulnerable population? Research practice should be oriented towards the wellbeing of the most vulnerable participant from the very beginning, and as interactants being ourselves vulnerable to change and transformation as the study goes on. Together, these implications only strengthen our capacity for bridging research and practice.

Traditional research on autism has already been critiqued by many others. For decades, the Autistic community has been advocating for a perspective on Autism as neurodiversity, so that their behaviors and social interactions may be interpreted not as idiosyncratic, but as meaningful in their own right. With the advent of this paradigm shift away from deficit-oriented practices, several scholars have argued for a holistic approach to the study of Autism that integrates cognitive, social, embodied, experiential, and affective aspects of autistic experience (De Jaegher, 2013; Gallagher, 2020; Nolan & McBride, 2015 etc.). This study proposes that a holistic approach to the study of Autism begins from an empirically driven agenda that increasingly forefronts the voice of the Autistic person.

As researchers, educators, and even family members interacting with vulnerable interactants, some ethical dimensions have yet to be considered. Firstly, music remains a culturally-sanctioned medium by those who are non-autistic, but nonetheless constitutes a widely accepted convention. Stimming should be embraced, even outside of the musical context. Secondly, although this study utilizes and develops technologically-mediated artifacts, as a tool, the MMM becomes part of a larger range of artifacts when brought into the everyday lives of autistic individuals. The development of MMM continues to be grounded in how it serves the human in-situ, and importantly, what participants are doing, even if it involves the MMM in surprising ways. Thirdly, MMM mediates intimate interaction, thus requiring care as consent around engagement is navigated. Lastly, now that MMM exists, there is much responsibility in its future dissemination so that it can be made accessible even to low-income families.

The process of critically examining our own interactional practices (Chen, 2021) is essential in any research agenda, especially when as researchers we work with populations that are more vulnerable than we are. Despite being constantly aware of my participation roles as I navigated the study, some important social actions went unnoticed by me. In my time with Nathan, if I had not been attending solely to readying the technology for the

session, I may have noticed how he was attempting to interact with me and shared in a participation framework with him. In this case, I missed an opportunity to learn from Nathan about the very tools I was building for him. As conversations around inclusion, equity, and diversity become more widespread, so must our work truly embody the ideals we discuss. I propose a reflexive research agenda of careful empirical work, where vulnerable voices continue to be foregrounded, and as researchers we keep learning to do better and better.

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5   Concluding remarks

Perhaps you think real voices
Only love people who can talk.
I cannot talk, but see how tall I walk.
I set goals, I think, I still make choices.
- fifi coo, 29 March 2016

To deny communication is to deny humanity. To live a meaningful existence as a human being is to be recognized as having a rich cognitive life, and to be capable of producing actions that are taken up by others as building a longer trajectory of action together (see also C. Goodwin, 2004). Thinking deeply about disability in my research practice has allowed me to understand what a privilege it is to have a voice and to participate in discourse and social life freely. Intimate interaction between differently disposed social actors can occur at any time at all, with or without tools like the floormats. Having a voice does not necessarily require the use of words, but rather begins from simply being with one another, in a safe environment that embraces diverse ways of being and interacting with others. This dissertation expands upon an understanding of autistic sociality beyond speech, and builds upon microanalytical, empirical work on interactionally-attuned stimming (Dickerson et al., 2007; Chen, 2016). This dissertation surfaces 'interactive stimming,' as defined by autistic writers, as a rich communicative practice for non-speaking autistic individuals.

The interactions between autistic and non-autistic interlocutors have been forefronted as the locus of the 'double empathy problem': "a disjuncture in reciprocity between two differently disposed social actors" (Milton, 2012, p. 884). Often, it is the more vulnerable communicator who bears the consequence of these disjunctures. But what does it mean to truly practice empathy if one was the more privileged interactant?

"If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music which he hears, however measured or far away."
- Henry David Thoreau, Walden

Stepping beyond the binary of 'speaking' and 'non-speaking' is to first understand sociality as interactional practices that occur through interweaving a multitude of modalities (see also Saverese, 2022; Sequenzia & Grace, 2015). Beginning a research agenda, the design of a tool, a class, a therapy session, or even an interaction from a place of welcoming diverse communicative modalities contributes to the communicative wellbeing of those whose expressive actions are more marginalized. But the onus is on those of us who do speak. When we interact with more vulnerable communicators than us, how do we come into attunement with them and take up their actions as valid compositions? Coming into attunement involves coming into a shared world of perception and action that allows people to build action together. Social interaction ultimately involves a change in one's state of being and engaging with a rhythm different from one's own.

As Maynard and Turowetz (2022) discuss, behavior that breaches *commonsense* "can occasion bewilderment, anxiety, or even chagrin on the part of others" (p. 59). Microanalyses of social interaction can provide evidence and accurate grounds for observable social phenomena (Garfinkel, 1967; Sacks, 1992), making "taken-for-granted" knowledge explicit by transforming tacit resources into topics that are elucidated in their own right (Watson, 2006). For the study of autism, this approach is "an opportunity to make the strange familiar" (p. 60) through surfacing units of analysis that may otherwise have gone unnoticed (Maynard & Turowetz, 2022). In this dissertation, paying close attention to the embodied interactions of non-speaking autistic individuals surfaces: (1) their diverse social actions; and, as such, reveals (2) opportunities for social *inter*action. These can easily be missed when the flow of verbal conversation is maintained and dominates the interactional space.

To make the strange familiar involves first opening oneself to noticing. Sometimes, the noticing can lead us to become aware of how our own actions could be improved upon (Chen, 2021; dissertation study 3). The next steps involve a continuous process of appreciating ways of being that differ from one's own, even if doing so alters one's commonsense. Empathizing with a differently disposed social actor is about opening oneself to transformation through contemplating dimensions of experience that are different from one's own (Chen, 2021; Liberman, 1999; Streeck & Chen, in press), and thus arriving at a new commonsense (see also Maynard & Turowetz, 2022).

As stated by Allen (2021), a non-speaking autistic writer, the presumption of competence—a principle of respect—by speaking interactants is not an act that can be completed. It is a constant work-in-progress by speaking others that requires making mistakes and learning from them. This dissertation pursues an interdisciplinary approach in the ethical development of new research and design practices that increasingly forefront the autonomous actions of autistic communicators. Firstly, through conducting video-based fieldwork and microanalyses of embodied interaction, this dissertation explicates the diverse interactional resources used by autistic individuals as they navigate daily life with speaking others. Identifying observable phenomena beyond verbal production surfaces other interactional practices, such as interactive stimming, which open doors for inquiry into expressive repertoires that are foundational to human sociality. Secondly, through including the researcher's participant roles as part of the analysis, this dissertation demonstrates how the actions of the researcher can have great influence over the course of the unfolding interactions being documented. As a researcher working with vulnerable participants, ethical dilemmas can arise when conflicting participant roles come into interplay during data collection and data analysis. Thirdly, through integrating reflexive video-based fieldwork within iterative cycles of design-based research, this dissertation critiques the pervasive foregrounding of the stream of speech by introducing novel artifacts— floormats that map interpersonal touch to sound—into the homes of non-speaking autistic children. Instead of intervening on the child, the study intervenes on their environment in order to consistently forefront social actions—such as interactive stimming—within the expressive repertoire of the autistic communicator.

This dissertation shows how sense and the senses are paths toward and objects of the empirical understanding of autism (Solomon, 2010a), and inquires into the autistic sensory experience beyond normative sensory ideals (Nolan & McBride, 2015). Studying the

interactions of non-speaking autistic individuals surfaces their ability to come into attunement (Merleau-Ponty, 1968; Meyer et al. 2017; Streeck et al., 2011) with others, objects, and the environment, co-operatively invoking structures within their social and material environment to construct meaningful practices with others (Chen, 2022; C. Goodwin, 2004, 2018). Stimming—the production of repetitive movement—is a core facet of the Autistic experience, being an "intrinsically motivating sensory event" (Nolan & McBride, 2015). Past research has demonstrated its attunement to larger sequences of interaction (Chen, 2016; Dickerson et al., 2007), its emergence in musical contexts such as drum circles (Bakan, 2014; Chen, in preparation), and its presence as "interactive stimming" in Autistic culture (Conn, 2015; Kapp et al., 2019; Sinclair, 2010). This dissertation shows how repetition is an important element not just in stimming by oneself, but in co-constructing embodied interaction with others. Autistic individuals in these studies improvise through cycles of repetition and variation, where sequences of utterances or movement can become public substrates for others to elaborate upon. The detailed analyses of these interactions reveal musicality as a dimension to be analyzed in social interaction, where participants engage in acoustic rhythm, melody, timbre. Adopting a musical ear on phenomena such as stimming and repetitive behavior more broadly opens an abundance of analytical possibilities for the study of human cognition, expression, and interaction. Interactive, expressive stimming also poses a tension to the common conceptualization of stimming as periodic self-regulation.

Embracing musical expression has potential to open doors for communication, healing, and learning. There is much potential for research and design in exploring autistic individuals' particularly sensitive relationship with sound. The last paper in this dissertation demonstrates how stimming can become even more expressive when mapped with touch and sound. Perhaps more importantly, all the stims reported in the first and third studies in this dissertation include the production of sound, even when they occurred naturally. The Magical Musical Mat demonstrates the potential of designing for sound interactivity. Making careful design decisions around sound sensitivity, aligning with the sonic preferences of non-speaking autistic individuals, and creating environments in which they can themselves create new sonic material with others, could more broadly inform research on sound perception and our human relationship with music.

For the practice of designing therapeutic interventions for non-speaking autistic individuals, this dissertation advocates for reflexive video-based fieldwork that first attempts to understand deeply their lived contexts. This dissertation project designed, developed, and implemented a technologically mediated tool that surfaces the multisensorial interactions of non-speaking autistic individuals. It joins a larger paradigm shift in designing for disability, towards moving beyond the individual and making physical environments more inclusive (Hart, 2014), marrying function with aesthetics (Pullin, 2009), as well as the idea of universal design for learning (Rose, 2000; Tancredi et al., 2021), where designing for multiple ways of learning, interacting, and being benefits not just those who are disabled, but everyone.

However, the technologically mediated MMM is a tool, not to be advanced in itself, but in constant relation to how it can serve the interactions of people who primarily interact through multiple modalities. Now that MMM exists, its dissemination and further development requires responsibility. Doing research and developing MMM has unveiled

potentially unethical ways in which the tool could be used, especially since it invites intimate interaction through touch. For example, MMM shall not be used as reinforcement or taken away as punishment, especially in the controversial therapy of Applied Behavioral Analysis (ABA). As another example, consent and guidelines around intimate touch-based interactions need to be an ongoing conversation, and proper training programs need to be designed for its implementation by therapists, educators, and parents. A code of ethical conduct around using the MMM needs to be developed prior to its release. The MMM's dissemination is also one to be done responsibly. MMM is not a toy, which would deem it a luxury item. Instead, the MMM is a therapeutic tool that should be made accessible even to low-income families. Lastly, if MMM in any way becomes a business endeavor, it is in my hope that non-speaking individuals head the project and benefit from it monetarily.

Issues around disability are at the very core of what it means to be human. As discourse around inclusion, diversity, and equity become more widespread, I hope conversations around disability will increasingly come to the fore in a way that is primarily motivated by what serves a better future for those who are disabled. I hope researchers who work with vulnerable populations increasingly bring disabled voices into their work and maintain a reflexive research practice in all respects, always centering those who are more vulnerable than oneself in one's research practices.

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