MASTERARBEIT | MASTER'S THESIS

Titel | Title

Inter-neurotype Intersubjectivity in Music Therapy for Children with Autism

verfasst von | submitted by

Alyssa Jasmine Hawkins

angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien | Vienna, 2024

Studienkennzahl lt. Studienblatt | Degree programme code as it appears on the student record sheet:	UA 066 013
Studienrichtung lt. Studienblatt | Degree programme as it appears on the student record sheet:	Masterstudium Joint-Degree Middle European interdisc. master prog. in Cognitive Science
Betreut von | Supervisor:	Assoz. Prof. Giorgia Silani Privatdoz. PhD

Abstract

The 'double empathy problem' refers to the phenomenon in which people of different dispositions encounter obstacles in mutual understanding. This concept is of rising interest in research on autism spectrum disorder (ASD), which is a neurodevelopmental condition that presents with social, emotional, and sensory differences. Although much of the evidence to date indicates that autistic people have difficulty understanding the perspectives and emotions of others, evidence is emerging indicating that these so-called impairments may not lie within the minds of autistic people, but rather in inter-neurotype interactions themselves. Because of sensorimotor and perceptual differences in autism, it may be that those on the autism spectrum engage with the world in fundamentally different ways than those who are not and it is this difference between neurotypes that impedes mutual understanding. The present thesis attempts to align enactivism, the double empathy problem, and neurodiversity-oriented perspectives on autism to examine the relational and interactive dynamics between non-autistic music therapists with autistic children during music therapy (MT) sessions.

To date, few studies have examined the relationships between music therapists' interactive and relational behaviors and the levels of interaction of autistic children during music therapy sessions. We sought to evaluate the therapist's playful interaction and emotional attunement with the child to determine whether these behaviors are related to the child's level of social interaction during music therapy and play therapy (PT) sessions. We also investigated these associations at different time points during the 12-week intervention to identify whether a history of shared experience led to changes in the intersubjective patterns between the child and therapist. We found that the therapist's attunement and playful interaction were significantly more highly correlated in MT compared to PT, which suggests that musical interaction affected how the therapist implemented attunement and playful engagement with the child. While there was a general tendency for behavioral associations to decrease over time, we observed markedly different patterns of interaction in MT compared to PT. An increase in the child's level of interaction in MT may be related to changes in therapists' relational and interactive dynamics. Although further investigation is needed to confirm these findings, musical intervention may facilitate a significant change in the interactional patterns of the mixed-neurotype dyad.

Key words: Autism, Double Empathy Problem, Music Therapy, Intersubjectivity, Inter-neurotype Interaction, Attunement, Enactivism

Zusammenfassung

Das „doppelte Empathieproblem“ bezieht sich auf das Phänomen, dass Menschen mit unterschiedlichen Dispositionen beim gegenseitigen Verständnis auf Hindernisse stoßen. Dieses Konzept gewinnt in der Forschung über Autismus-Spektrum-Störungen (ASS) zunehmend an Bedeutung. Autismus ist eine neurologische Entwicklungsstörung, die mit sozialen, emotionalen und sensorischen Unterschieden einhergeht. Obwohl ein Großteil der bisherigen Erkenntnisse darauf hindeutet, dass Autisten Schwierigkeiten haben, die Perspektiven und Emotionen anderer zu verstehen, gibt es immer mehr Hinweise darauf, dass diese so genannten Beeinträchtigungen möglicherweise nicht im Kopf der Autisten liegen, sondern eher in den Interaktionen zwischen den Neurotypen selbst. Aufgrund der sensomotorischen und wahrnehmungsbezogenen Unterschiede bei Autismus kann es sein, dass Menschen auf dem Autismus-Spektrum die Welt auf eine grundlegend andere Art und Weise wahrnehmen als Menschen ohne Autismus, und es ist dieser Unterschied zwischen den Neurotypen, der das gegenseitige Verständnis behindert. In der vorliegenden Arbeit wird versucht, den Enaktivismus, das doppelte Empathieproblem und neurodiversitätsorientierte Perspektiven auf Autismus in Einklang zu bringen, um die Beziehungs- und Interaktionsdynamik zwischen nicht-autistischen Musiktherapeuten und autistischen Kindern während Musiktherapiesitzungen (MT) zu untersuchen.

Bisher haben nur wenige Studien die Beziehungen zwischen dem interaktiven und relationalen Verhalten von Musiktherapeuten und dem Grad der Interaktion autistischer Kinder während Musiktherapiesitzungen untersucht. Wir haben versucht, die spielerische Interaktion und die emotionale Einstimmung des Therapeuten auf das Kind zu bewerten, um festzustellen, ob diese Verhaltensweisen mit dem Niveau der sozialen Interaktion des Kindes während der Musiktherapie (MT) und der spielbasierten Therapie (PT) in Verbindung stehen. Wir untersuchten diese Zusammenhänge auch zu verschiedenen Zeitpunkten während der 12-wöchigen Intervention, um festzustellen, ob eine Anzahl an gemeinsamer Erfahrungen zu Veränderungen in den intersubjektiven Mustern zwischen Kind und Therapeut führte. Wir fanden heraus, dass die Einstimmung des Therapeuten und die spielerische Interaktion in der MT signifikant stärker korreliert waren als in der PT, was darauf hindeutet, dass die musikalische Interaktion einen Einfluss darauf hatte, wie der Therapeut die Einstimmung und die spielerische Auseinandersetzung mit dem Kind umsetzte. Während es eine allgemeine Tendenz gab, dass die Verhaltensassoziationen im Laufe der Zeit abnahmen, beobachteten wir deutlich unterschiedliche Interaktionsmuster in MT im Vergleich zu PT. Der Anstieg des Interaktionsniveaus des Kindes in der MT

könnte mit den Veränderungen in der Beziehungs- und Interaktionsdynamik der Therapeuten zusammenhängen. Obwohl weitere Untersuchungen erforderlich sind, um diese Ergebnisse zu bestätigen, könnte die musikalische Intervention eine signifikante Veränderung der Interaktionsmuster der zwischen-Neurotyp Dyade erleichtern.

Schüsselwörter: Autismus, Doppeltes Empathie-Problem, Musiktherapie, Intersubjektivität, Zwischen-Neurotyp Interaktionen, Attunement (Abstimming) Enaktivismus

Acknowledgements

I would first like to thank everyone who mentored and assisted me in completing this master's thesis. I would like to extend my deepest appreciation to Maayan Salomon-Gimmon, without whose mentorship and guidance this thesis project would not have been possible. A sincere thank you to my supervisor, Giorgia Silani, for her invaluable input and direction as I developed and investigated my research questions. I would also like to express my appreciation to Christian Gold for his help and feedback with data analysis, and to everyone else I've had the occasion to work with in the M4A project. I greatly appreciate the opportunity you all have given me to take part in this project and to grow as a researcher.

Next, I would like to express my appreciation for those who have supported me in my work on this project and beyond. Thank you to my parents, Jen and Dave, who fostered my curiosity, ambition, and eagerness to help others. Thank you to Johanna and Gottfried, for your continuous patience and kindness. I am also grateful for my brother, extended family, and cats for always being there. My love goes to you all.

And of course, a final thank-you to Jakob. Thank you for the late nights and study breaks, the seemingly endless encouragement, and all the laughter. I can't wait to see what's next for us.

Contents

1. Introduction

Autism Spectrum Disorder (hereafter autism) is formally understood as a heterogeneous neurodevelopmental disability characterized by social and communication difficulties, sensorimotor and affective differences, repetitive or routine behaviors, and focused, intense interests (American Psychological Association, 2013). A commonly held stereotype about individuals on the autism spectrum is that they have an impaired ability to relate to or understand others' perspectives. Notably, however, as cultural and societal views on neurodiversity change, the scientific perspective on intersubjectivity in autism is transforming. The double empathy problem, as defined by autistic autism researcher Damien Milton in 2012, refers to how individuals with vastly different backgrounds struggle to gain insight into each other's experience. Cognitivist and medical perspectives on autism have primarily positioned social and communicative challenges presented by the condition in the minds and bodies of autistic people. Research in this area has focused on uncovering the neurological and psychological differences underlying these challenges. However, these avenues of investigation fail to acknowledge the reciprocal and contextual nature of social interactions. Therefore, examining mismatches in neurotype may be more appropriate for elucidating the social-communicative difficulties purported to be due to an interactor's autism. Additionally, little effort has been made to understand the nature of autistic intersubjectivity and empathy, because these concepts have been restricted to neurotypical norms and attitudes (Fletcher-Watson & Bird 2020). As a result, the autistic experience and autistic voices have long been excluded from empirical contexts, and by extension from our collective understanding of autism to the detriment of the autistic community.

Music therapy is an evidence-based intervention in which a music therapist employs various aspects of music to address the needs of clients. In this context, music provides an alternative mode of expression that can be used in lieu of verbal or nonverbal communication to foster the emotional and expressive needs of autistic children. Music therapy may be an impactful intervention for autistic children because it may help develop or strengthen the skills needed for social interaction, partly due to the nonlinguistic, yet communicative nature of music. More work is required to uncover the features of musical intervention that facilitate improvements in symptom severity and social communication outcomes for autistic children. In this respect, closer investigation also needs to be given

to the intersubjective and interactive dynamics in the therapist-autistic child dyad to determine not only the impact of music during the intervention, but also the therapeutic processes that are particularly influential in establishing shared meanings and togetherness during sessions. The present work will examine the intersubjective patterns between autistic children and nonautistic music therapists in musical and play-based therapy. Particular attention is paid to the therapist's relational and interactive behaviors, which include emotional and musical attunement, and playful interaction with the child. The child's level of interaction with the therapist, which could include eye contact, verbal communication, and joint attention, among other behaviors, shall also be assessed in relation to the therapist's behavior. We will investigate whether these three components are related and whether they are influenced by musical intervention. Because social interactions are mediated by our past experiences with others, it is also pertinent to consider whether the developing relationship between the child and therapist impacts these behaviors and if a history of mutually created experiences facilitates interpersonal relating in this setting.

Interdisciplinarity statement: The central aim of this thesis is to investigate the relational and interactive patterns between autistic children and nonautistic adults in a music therapy setting. Elements of psychology, neuroscience, and linguistics will converge to examine the differences between autistic and nonautistic interactive styles. Specifically, this thesis calls upon findings from social cognition, cognitive development, autism research, social and sensorimotor neuroscience, language development, verbal and pragmatic language, and music therapy (including aspects of clinical and counseling psychology). Moreover, this work is directly linked to cognitive science through the lens of the enactive view of cognition. The enactive approach lends itself to the perspective that autism is a condition that affects how people experience and perceive their environment and how differences in these processes can create uncertainty during social interactions with others.

1.1 Perspectives on Autism

Autism was first identified in the early-to the mid-1940s independently by Leo Kanner and Hans Asperger, who worked with individuals who were observed to have atypical language development, difficulty relating to others, and proneness to sensory

sensitivity and repetitive behavior (Masi et al., 2017). Since then, many strides have been made from a clinical viewpoint to understand the psychological and neurological irregularities that underlie the condition, in addition to uncovering treatment options that aim to help autistic people with various difficulties they may encounter due to their developmental differences. There are many indications that autism is heritable, and it has also been shown to be associated with neuroanatomical differences (Genovese & Butler, 2020; Donovan & Basson, 2016). Autism frequently presents with co-occurring conditions like ADHD (attention deficit hyperactivity disorder), cognitive impairment, depression, and anxiety (Lord et al., 2018). Gastrointestinal issues, tics, sleep disturbances, specific phobias, and food aversion may also co-occur with autism during childhood (Mannion & Leader, 2013). Autism diagnoses have become much more prevalent in recent years due to improved diagnostic testing and a broadened understanding of autistic traits and their presentations. Increased rates of diagnosis are also due in part to improved recognition of autism in women and girls as well as expanded testing for adults (Russell et al., 2021).

Social and communication difficulties are perhaps the most studied characteristics of autism, particularly concerning whether and how autistic individuals understand and connect with the perspectives of others. Theory of Mind (ToM), also known as 'mindreading,' or 'mentalizing' is a cognitive skill in which a person ascribes mental states, and with them intentions, beliefs and desires, onto others. This ability has been described as a central component of human sociality, which is critical for relating to and caring for others. The idea that ToM is deficient in autistic children originates from a seminal study by Baron-Cohen et al. (1985). They evaluated the performance of autistic children, children with Down syndrome, and typically developing children on a false belief task that required them to correctly predict the behavior of a target by inferring the target's beliefs and disregarding their own knowledge of the reality of the situation (the Sally-Anne Task). The authors concluded that, due to their inability to correctly impute false beliefs, autistic children were specifically incapable of attributing a mind to others. In the wake of these findings, a significant body of research has been conducted to explain 'deficient' ToM in autism. Subsequent results have been inconsistent; however, with some autistic participants demonstrating intact ToM performance.

It is important to note that ToM is a complex construct that incorporates implicit and explicit mechanisms as well as cognitive and affective components. Because of this

complexity, the concept of ToM has been used inconsistently in research, and measures of ToM skill have also been shown to have low ecological validity, both of which are important caveats to consider when reviewing the literature in this area (Hutchins, 2016; Rosello et al. 2020). However, research has primarily focused on determining which ToM mechanism is specifically affected in autism, while attempting to justify any high performance by autistic participants to be the result of compensatory strategies. There are several other methodological concerns surrounding the validity and applicability of claims regarding deficient ToM in autism, as argued by Gernsbacher and Yergeau (2019). For example, various ToM tasks (e.g., Strange Stories task (Happė, 1994) and Reading-the-Mind-in-the-Eyes Task (Baron-Cohen et al., 2001)) fail to correlate with one another, which the authors argue "undermines the core construct validity of theory of mind" (p. 108). Moreover, performance on measures of ToM ability, such as the false-belief task, has been shown to depend heavily on other cognitive skills, such as narrative comprehension and verbal language ability (Bloom & German, 2000; Rosello et al., 2020). As a result of these concerns, whether 'deficient' ToM ability can explain social differences in autism remains unclear.

An alternative explanation for social differences in autism is the theory of MNS dysfunction, sometimes referred to as the 'Broken Mirror Hypothesis'. Mirror neurons are premotor neurons that activate when an individual initiates a goal-oriented motor action or when they perceive another person executing such an action (Rizzolatti et al., 1996). MNS-oriented theories, in alignment with the simulation perspective of social cognition, suggest that our understanding of others' minds does not only rely upon metacognitive strategies. Rather, our understanding depends upon a more direct comprehension of the actions, emotions, or sensations others experience by directly mapping them onto our own neuronal representations responsible for the same action or sensation. MNS dysfunction accounts suggest that alterations to brain regions constituent of the MNS are associated with qualitative differences in how autistic people engage in imitation, social interaction, and communication. Impacted brain regions include the amygdala, prefrontal cortex, and superior temporal sulcus, which are implicated in biological action and eye gaze perception, social initiation and social processing, and ToM (Oberman & Ramachandran, 2007). In this vein, Gallese (2006) suggests that malfunctioning embodied simulation, underpinned by MNS dysfunction in autistic people, negatively impacts their ability to experience the phenomenal state of feeling, acting, or perceiving "as if" they are another

person (pp. 19-20). He states that autistic children are incapable of establishing meaningful, emotional bonds with others as a result (pp. 21-22). However, Gallese does not consider how perceptual and sensorimotor differences might affect an individual's embodied simulation processes in general, but also with respect to autism. We will return to the subject of autistic embodiment in the upcoming sections.

Aside from differences in social behavior, the American Psychological Association (2013) notes that movement differences, focused interests, and atypical language are common autistic traits. These characteristics are not always included in accounts that focus on autistic social and communication differences and are explained instead through the lens of other cognitive processes such as perception, attention, language, or memory. One such matter is executive function, which refers to several higher-order cognitive processes that subserve goal-oriented behavior, including abilities like working memory and attentional control. These cognitive skills function as a 'controlling' mechanism, aiding in the performance of tasks that involve planning or reasoning. In autism literature, affected executive function is thought to impact inhibitory control and attentive differences observed in autistic subjects. It may explain some of the observable variation in behavior in autism including the need for routines or predictability in the environment and for idiosyncratic movements. It may also support the notion of a ToM deficit because executive function helps us to reason about other people's perspectives (Demetriou et al., 2017). Difficulties with adaptive behavior, self-regulation and paying attention are all potential symptoms of executive dysfunction in autism. However, we still do not know whether core autistic traits related to executive function might arise from input from other cognitive, perceptual, or motor systems (Pellicano, 2012). Relating to differences in perception, the notion of weak central coherence conceptualizes the autistic perceptual and attentive systems as detail-oriented and prone to missing the "greater picture" of a situation (Frith 1989). Weak central coherence was initially positioned as a deficit in the integration of information needed to comprehend the full meaning of a situation; but it may in fact indicate superior processing of detail-level information compared to neurotypical people (Happé & Frith, 2006). Evidence supporting weak central coherence as a feature of autism is mixed, and moreover, it might be appropriately conceptualized as a cognitive style found in both autistic and neurotypical populations (Fletcher-Watson & Happé, 2019, p.159).

It is noteworthy that the above theories about the mechanisms or causes for differences in social communication and other cognitive traits in autism are accompanied by extensive methodological and theoretical drawbacks. Social impairment models of autism, for instance, are expressly problematic in terms of ecological validity, as people – autistic or otherwise – behave differently on these tasks than they would in their real lives (Chapple et al., 2022). We should also consider the attitude taken by researchers with regard to how experimental tasks are assessed when we appraise differences between neurotypes. Despite the vast heterogeneity seen in the autism spectrum, little consideration is made for the possible role of individual differences, which are readily borne in mind in literature for non-clinical populations in psychology and linguistics, for example (Marocchini, 2023). Marocchini (2023) also notes that nonautistic researchers cause implicit neurotypically normative biases in research design. Not only are assessments in autism research "neurotypically derived" (meaning that they are created and measured based on what is 'correct' or accurate for nonautistic people), they are often formulated with an assumption of deficits. For instance, if autistic people perform well on measures that they are not expected to, it is frequently reported to be a result of compensatory or alternative strategies rather than proficiency (pp. 370-371). This tactic problematizes how we approach autistic cognition on a general level. Lastly, the above approaches have been criticized on account of insufficient consideration for social interaction processes, embodied experiences, and cognitive development (for review, see Fuchs & De Jaegher, 2009, pp. 466-469). In other words, little heed has been paid to how autistic people experience the world or to the dynamics of interactions as they unfold – especially across neurotypes – which will be the focus of the rest of this section.

1.1.1 The Enactive View of Cognition

The enactive view of cognition (Varela, Thompson & Rosch, 1991) conceptualizes cognition as an emergent property of self-individuating systems involving not only the mind but also the living body and its meaningful interaction with the world around it. Cognitivist models distinguish the mind from the body; they suggest that what is "out there" in the real world is firmly separated from the internal representations and processes occurring within our heads. Enactivism, however, holds that cognitive and biological systems are intertwined and that sensorimotor experiences are significantly linked to

mental processes (De Jaegher, 2013). The continuity between mental and biological systems explains how organisms find significance within their world. As Di Paolo & Thompson (2014) explain, cognizers are understood as autonomous systems that maintain their self-organization through interrelated processes that enable the continued existence of the system given the precarious nature of being alive. Crucially, the cognitive system maintains the self and its processes with respect to its situatedness in the environment through adaptivity and sense-making. Sense-making arises through active engagement and experience with the environment and gives the world significance based on the system's needs or goals, such as ensuring its survival. By regulating its coupling with the environment, the organism maintains its identity and gives significance to the environment in which it finds itself (Di Paolo & Thompson, 2014, pp. 69-74).

But how does enactivism account for social interaction and intersubjectivity? Intersubjectivity is a recurring concept among several disciplines and can have varying definitions. Simply speaking, intersubjectivity refers to an interchange between two or more people's perspectives. There are various ways in which cognitive perspectives may relate in this way, from a shared understanding of objects in the world, to hypothesizing about others' views or intentions, and to realizing a mutual awareness about intersubjective breakdowns (see Gillespie & Cornish, 2010). From neurological or psychological viewpoints, intersubjectivity could rely upon MNS or cognitive systems like ToM to simulate or theorize about other people, informing how we interact and relate with them. Within the enactivist paradigm, intersubjectivity becomes *participatory sense-making*, a dynamic process where interactors co-create meaning through their interactions and mutual influence. De Jaegher and Di Paolo (2007) suggest that social interactions take on their own autonomous organization through the coupling of two (or more) autonomous agents while keeping the individual autonomy of those agents intact. In a dyad, the interactive dynamics of this coupling, in addition to the situational context and other relevant factors of such interactions, affect both individuals' sense-making through the coordination and joint task of formulating shared meaning (pp. 493-497). Through coordination and mutual engagement, both interactors participate in each other's sense-making processes and co-create shared intentions. De Jaegher (2013) states, "When we engage in interaction, not only the participants, but also the interaction process as such modulates the sense-making that takes place. This means that intentions can be truly understood as generated and transformed interactionally" (p. 7).

This is taken a step further by Fuchs & De Jaegher (2009), who unite this concept with the phenomenological notion of *mutual incorporation,* which refers to the reciprocal, active embodiment of the other during social interaction via varying degrees of coordination and synchrony. They use the analogy of a player in a tennis match. The player not only incorporates their racket and the ball whizzing back and forth on the court as they navigate the game, but they embody the stance and motions of the opposing player. The player's next action is influenced by this, and in fact, the ongoing volley of the ball back and forth is co-constituted by both players' reciprocal embodiment of the other, in a feedback/feedforward cycle, until something breaks the coordination (p. 474). Coordination like this occurs in day-to-day settings with nearly everyone we encounter. Busy people making their way in a train station, for example, subconsciously sidestep each other so that both may continue on their way. Both agents jointly recognize and embody the other's motor intentions, and, in this way, they move in tandem. When people are more familiar with one another, coordination and synchrony can be observed in the rhythm or resonance of affective states, facial gestures, and movement, revealing the coupling of interactors' perception-action cycles (De Jaegher, 2013). Moving beyond brief interactions through coordination, Fuchs & De Jaegher posit that early social cognitive processes do not presuppose a capacity for inferring mental states. Instead, infants are born with an innate sense for mutual incorporation, evidenced by e.g., babies imitating caregivers' smiles. This form of imitation is a form of affect matching, as both the caregiver and infant come to share an emotional state. Imitative and coordinative interactions like these begin to develop into a sort of discourse between child and parent facilitated by the parent's emotional attunement to the child. They state that in early infant interactions, intersubjectivity "develops in a practical sense, a musicality for the rhythms and patterns of the early dialogue" (p. 482). Having established a brief overview of the enactive perspective of cognition, we can now examine autism from this alternative approach which better accounts for the roles of perception, action, and the complexity of interaction regarding autistic social communication differences.

1.1.2 Re-examining Autism and Autistic Embodiment

Aside from neglecting social interaction dynamics, a significant issue with the characterization of autism as a social communication disorder is that it overlooks the

embodied experience of the autistic person and how that may affect their social and communicative behaviors with nonautistic individuals. Here, we will rely primarily on De Jaegher (2013), who describes autism through an enactive lens, focusing on the role of embodiment and sense-making in the heretofore conceptualized 'social-communication deficits' present in autism. This perspective takes a holistic approach, focusing on sensorimotor and affective differences in autism and how they may impact how autistic people navigate social interactions. She argues that executive function, weak central coherence, and ToM deficit accounts do not sufficiently describe the various cognitive and affective differences in autism (while also neglecting social interaction processes and the embodiment and situatedness of the autistic person). A theoretical issue with the 'triad of impairment' perspectives is that they 1) are poorly integrated theoretically, and 2) focus on relatively high-level cognitive processes that emerge later in development when it may be more appropriate to examine more fundamental precursors for these abilities (pp. 3-4). She attempts to bridge what she refers to as "autistic psychology" and "autistic embodiment" to demonstrate how autistic people perceive and engage with the world in fundamentally different ways from nonautistic people, noting that the 'why and how' of perceptual and motor differences have gone unexplored in autism instead of treating them as symptoms (p. 8). Her review outlines how sensorimotor differences impact autistic sense-making, consequentially affecting participatory sense-making with others. From first-hand autistic accounts to empirical ones, she points to ways in which autistic people experience the world and their bodies differently from those who are not on the autism spectrum. We shall first review differences in embodiment and perception before addressing autistic sense-making and participatory sense-making.

Repetitive behaviors observed in autism, in tandem with differences in movement, bodily perception, and sensory sensitivity may point to fundamental differences in how autistic people engage with the world from nonautistic people (Donnellan et al., 2013; De Jaegher, 2013). Despite growing acknowledgment of neurological differences in autism, repetitive or atypical motor actions or incoherent behaviors are often understood as volitional (and may be targeted for "correction" during intervention). As noted by Donnellan et al. (2013), the social and behavior-oriented interpretations of autistic (in)actions regard them as if they are performed willfully. This is in direct contrast with conditions viewed from a firmly neurological perspective. For example, tics associated with Tourette syndrome, while perhaps disruptive, are understood to be unintentional. On

the other hand, movement disturbances that occur in autism are viewed as if they are always done on purpose, rendering such behaviors to be viewed as non-compliant, lazy, or obstinate. Kinetic disturbances in autism have primarily been viewed as outlying or comorbid conditions, however, it is noteworthy that these differences may disrupt social interaction and coordination due to postural and timing differences (Leary & Hill, 1996). Donnellan et al. (2013) argue that:

> "In the course of development, if individuals move and respond in idiosyncratic ways from infancy, they will experience all interactions within a unique frame that most certainly differs from that which is called typical. The cumulative effect of such interactions will be one in which all aspects of relationships, including how to establish and maintain them, may be markedly skewed from the broader cultural consensus and expected rules of how relationships work" (p. 3).

Movement and embodiment differences have also been observed with respect to motor planning and execution, and differences in reaction time, posture, gait, and muscle tone (for review, see De Jaegher, 2013, pp. 8-10).

These kinetic differences may be supported by differences in physiology. For instance, evidence is emerging that autism and other neurodevelopmental conditions may be linked with joint hypermobility disorders and dysautonomia, a condition characterized by the dysfunction of the autonomic nervous system (ANS). The ANS is responsible for unconscious or involuntary bodily processes, like heart rate, digestion, other organ function, and reflexive actions like coughing. Both dysautonomia and joint hypermobility, a condition that directly impacts connective tissue and mobility, were shown to be significantly more prevalent in the neurodivergent population, with hypermobility occurring twice as often as in the control sample (Csecs et al., 2022). Alexithymia, which refers to the difficulty in identifying one's emotions, and interoception are also co-occurring conditions with autism. Interoception refers to our sensation of internal bodily signals (like hunger) and may be involved in our awareness of other people's bodily states. Higher degrees of interoceptive awareness have been linked positively with both cognitive and affective empathy, which may point to the importance of the role of bodily experience in understanding and relating to others (Mul et al., 2018). These are just a few examples of differences in bodily constitution and sensation that might affect how autistic people experience the environment leading to atypical interactive behaviors with others.

Intense, circumscribed interests observed in autism may be understood as differences in how one's attention is focused. This is to say that individuals with autism could be considered to have a *Monotropic* mind, which would indicate that they have a narrower center of attention, focusing deeply on the things that are the most stimulating to them, thereby missing details from the broader context. Lesser and Murray (2020) suggest that this "Monotropic Condition," or attention tunnel, is a central feature of autism, which is moderated in their model of the interest system by a variable controlling the strength of feedback between interests. In this "Monotropic calibration," fewer interests are highly aroused, which results in behavioral differences of the same degree. They proceed to state that this capacity for extreme depth of arousal results in a small capacity for breadth of arousal, leaving little room for a larger array of interests (pp. 14-16). Furthermore, they provide cause for atypical sensory processing for autistic people because their neurotype calls for "high sensory acuity and an ability to withstand pain" in pursuit of their interests (p.15). In terms of sensory perception, there is abundant evidence that people on the autism spectrum experience both hypo- and hypersensitivity to external stimuli. Lights, scents, and sounds can be very overwhelming – and perhaps even painful – for many autistic individuals. On the other hand, sensations and repetitive movements can provide positive stimulation, and as De Jaegher (2013) puts it, are meaningful for autistic people in accordance with their sense-making because the notion of what is significant to an organism in the enactive paradigm is wholly relative to the individual and should therefore be examined from their perspective and situated context (p. 10).

The above evidence describes two key aspects of autism, differences in embodiment, and the differences in sense-making that arise as a result. The social consequence of sensorimotor and sense-making divergence is atypical participatory sense-making and mutual incorporation. De Jaegher (2013) draws attention to how these affect rhythm and timing differences, as it has been observed that autistic individuals act "awkwardly" in coordinative efforts with others. For instance, Carnevali et al. (2024) reported that interpersonal motor synchrony, the spontaneous and temporal coordination of motor actions that is thought to be atypical in autism, is prevalent in mixed-neurotype dyads. Although more research is needed to understand the cause for differing coordination dynamics in autism, coordinative differences are supported by variations in interactional timing, rhythm capacity, and a lack of flexibility between interaction partners (p. 12). Findings also reveal imitative differences in autistic children, who are adept at imitating

an action but are not able to evoke *how* the action was completed (Hobson 1999, cf., De Jaegher, 2013). Impaired ability to emulate the quality of actions (and the emotional or intentional aspects thereof) may indicate significant differences in how autistic children experience mutual incorporation which also affects intersubjective experiences and participation with others in sense-making.

Lastly, there are alternative accounts for social and affective capacities in autism that might further reframe deficit-based models. For example, it has been demonstrated that individuals with autism behave differently from typically developing people in their perception of affective stimuli but that these differences may be due to attentive processes. McKenzie et al. (2021) found that anger was the only emotion that autistic young adults had trouble detecting compared with nonautistic participants. They propose that, although this could be due to differences in perspective-taking, it may occur because of attentional bias, given that anger could be considered particularly threatening or unpredictable (pp. 2012-2015). Other approaches toward investigating social cognition have demonstrated noteworthy differences in how the autistic population forms relations with others. Autistic readers, for example, reported experiencing embodied and empathetic engagement with serious literature (non-fictional works detailing impactful situations that may evoke emotional responses). Chapple et al. (2022) found that autistic people could relate to the people and events in these stories without imposing their own perspectives onto the characters, challenging ToM and empathy deficit models of autism. The authors propose that because of their experiences receiving less mutuality from nonautistic peers, they may even have a greater advantage in social-emotional understanding in this way (p. 12). In these cases, it may be easier for autistic people to relate with others because sensory and interactional timing demands are alleviated. It has also been observed that there is an increased tendency for anthropomorphism, or object personification, by autistic individuals than nonautistic people (White & Remington, 2019). While it could be a form of synesthesia, the authors suggest that personifying objects might also be a mechanism for coping with social isolation or uncertainty. The use of toy animals has also been shown to facilitate affective and intersubjective experiences for autistic children with adults, suggesting that this variety of 'interactional substrate' enables a higher degree of social connection for autistic children (Solomon, 2015). De Jaegher (2013) notes that properties within the social environment may be less salient to autistic children, evidenced by atypical eye gaze toward social features of the face and eyes or to objects of gestural

communicative efforts like pointing. Moreover, autistic children demonstrate a preference for attending to inanimate stimuli over social stimuli and may be less sensitive to biological motion (p. 11). Together, these findings illustrate how autistic social abilities may be more complex than first thought, pointing to differences in how autistic children and adults perceive and interact with social and affective stimuli.

The enactive view on autism and its divergent social and communicative characteristics emphasizes the embodiment and situatedness of the autistic cognizer, highlighting that atypicality in these domains points to the fundamentally different enaction of the environment in autism. Furthermore, sense-making and sensorimotor differences between autistic and nonautistic people impact the way that they interact and relate with each other. Notably, according to the double empathy problem, intersubjective hurdles occur across neurotypes. But what about inter-autistic interactions? Do autistic and nonautistic people engage more fluently in social interactions with others of the same cognitive disposition?

1.2 The Double Empathy Problem

In the previous sections, I have presented some of the principal theories for autism and have further attempted to reframe or otherwise provide counterevidence against those that support deficit-based models. In the current section, I will introduce the double empathy problem and the evidence that supports it. It is important to note that some theories position autism in a way that suggests that it needs to be 'cured' or otherwise 'managed' so that the autistic person may fit in with the social majority. Milton (2012) makes the argument that, despite the empirically sound nature of many such studies about autism, in neglecting the actual, subjective experiences of autistic people, we fail to acknowledge that social interactions involve r*eciprocity* and *mutuality*, neither of which are extended to the autistic population. He defines the double empathy problem (DEP) as follows:

> "[A] disjuncture in reciprocity between two differently disposed social actors which becomes more marked the wider the disjuncture in dispositional perceptions of the lifeworld – perceived as a breach in the 'natural attitude' of what constitutes 'social reality' for 'nonautistic

> spectrum' people and yet an everyday and often traumatic experience for 'autistic people'." (Milton, 2012, p. 884)

According to Milton, while autistic people may struggle to gain insight into the feelings of nonautistic people, it is also the case that nonautistic people fail to empathize with those on the autism spectrum, either because it is difficult, or because they fail to consider the autistic experience. Furthermore, he contends that autistic individuals, needing to survive in a predominantly nonautistic world, are more adept at grasping nonautistic culture and norms, an attitude that is infrequently reciprocated by nonautistic people (p. 886). The DEP suggests that we reframe the "social deficits" purportedly present in the minds of autistic people as social differences that do not align with neurotypical social norms. Therefore, it may be prudent to replace the notion that autism is a social communication disorder with the idea that there is a pervasive and mutual struggle for autistic and neurotypical people to relate with and understand one another.

Anecdotally, many autistic people report that they have an easier time getting along with other autistic people. Social interaction may be easier because other autistic people are more empathetic to the needs, feelings, and behaviors of others on the spectrum which may lead to an improved sense of belonging for autistic people (Crompton et al., 2020a). These accounts contrast with autistic experiences with NT peers and family members reported in the same study. Autistic respondents expressed that, despite enjoying spending time with neurotypicals, it can be challenging because these interactions require them to behave and communicate in neurotypically normative ways that may require them to neglect or manage their sensory preferences or needs. The rest of this section will provide an overview of studies that support the DEP through examinations of social interaction between autistic and nonautistic people and autistic-autistic social interactions.

1.2.1 Inter-Neurotype Intersubjectivity

Researchers have recently started to consider the bi-directional nature of interactions in the realm of autism research, in addition to probing more closely the social cognitive abilities of nonautistic people. Although previous empirical work has indicated that social challenges arise because of differences in cognitive and emotional functioning in autism, evidence is emerging that shows that neurotypical people experience difficulties interacting with those on the spectrum as well. A study conducted by Sheppard et al.,

(2016), evaluated whether and to what extent neurotypical adults were able to interpret the internal states of autistic adults. They found that neurotypical people have trouble interpreting the behaviors and by extension the mental states of their autistic counterparts. Despite sufficient expressiveness, autistic behavior seemed less straightforward for nonautistic observers, leading them to refer directly to inferred internal states rather than the actual observed behavior. The authors propose that some of the difficulty individuals on the spectrum face with socializing may be due to this tendency for neurotypical interlocutors to misinterpret their mental states.

The way that autistic people are perceived by those who are not autistic is also a relevant factor to consider regarding their access to social interactions. Across three studies, Sasson et al. (2017) showed that neurotypical observers – children and adults alike – are prone to negative first impressions of autistic peers. Negative judgments were shown to be influenced by social presentation traits like awkwardness and likeability, which could be determined by prosodic language and postural or expressive differences (p. 7). Importantly, negative first impressions by neurotypical people may be an unexplored factor relating to the quantity and quality of social opportunities for autistic people, particularly in how they are a direct basis for minimized social initiation. Likewise, negative first impressions by neurotypical individuals have profound implications for autistic children, who were perceived negatively not only by observers of the same age but also by adults. The authors state that "despite being at an age when intense attention is often paid to social skills training, the ASD children are nonetheless rated poorly by both adults and same-age observers. Negative first impressions by adults may affect how children with ASD are perceived and treated by educators, and similar impressions by same-age observers may limit the formation of social networks and friendships" (p. 7).

Negative attitudes towards autistic children are a little-considered factor in their social development and the effect that they may have on early friendships and social opportunities may contribute to impaired social ability and longer-term mental health problems. Mitchell et al. (2021) note that being misunderstood or misperceived has a major impact on social development in autism and contributes to negative mental health outcomes in adulthood. They assert that medical perspectives of social differences in autism (e.g., ToM deficit) should be adapted toward more socially developmentally appropriate frameworks. Building on work by Hobson (1990), Karmiloff-Smith (1998),

and Lopez (2015), they provide cause for adjusting our view on autism based on the idea that our knowledge about other people is grounded in our experiences of interpersonal relations; the way that people react to our respond to us affects how we behave in future, creating an ongoing cycle of social feedback and behavioral adjustment. This transactional model for social development, in tandem with the DEP, suggests that a potential source of difficulty for autistic people getting along in social contexts is repeated experiences of being misunderstood or negatively perceived. Accordingly, this is a mutual issue that neurotypical people also experience when, for instance, their social cues are misread, which may further exacerbate social difficulties in future cross-neurotype social interactions.

Aside from the effect of negative perceptions of autistic people on their interactions, communicative styles across neurotypes seem to be an additional factor. In their study on inter- and intra-neurotype interaction, Crompton et al., (2020b), tasked participants with a transmission-chain communication task (not unlike the "Telephone game") wherein a message is whispered from one person to the next. Afterward, the original and final messages are compared to see how the message has changed. In this study, the groups were either all autistic, all neurotypical, or mixed. The researchers investigated whether the message could be accurately relayed within the groups in addition to evaluating participant-rated interpersonal rapport. Rapport refers to a feeling of being 'in sync' or relationally compatible with another person that comes with a sense of ease and comfortability in getting along. They observed that participant-rated rapport was lower, and that communication breakdowns were more prevalent, in mixed-group interactions. However, rapport was rated higher, and signal transfer was consistently effective, in groups of only neurotypical and only autistic people. These results indicate that neurotype-mismatch influences not only communicative efficacy but also interpersonal harmony. High within-neurotype rapport was further supported by Crompton et al. (2020c), who found that participants in inter-neurotype dyads rated rapport lower in comparison to participants in within-neurotype pairs. Interpersonal rapport was also rated low for mixed-neurotype pairs by both autistic and nonautistic third-person observers. Observer ratings additionally indicated that rapport was very high for autistic pairs. These results directly contradict deficit-based models of social differences in autism, because if social impairments are inherent to the autistic individual, one would anticipate that such social difficulty would be compounded when two autistic people interact with one another.

However, because these findings do not corroborate this notion, they lend credence to the double empathy problem and show that interaction quality is impacted across the neurotype divide.

Furthermore, autistic and neurotypical self-perceptions may also influence mixed-neurotype social interactions. Sheppard et al. (2024) conducted an online study to determine whether and how well autistic and nonautistic individuals believe that they can read the minds of autistic and nonautistic peers. They found that autistic and nonautistic people's beliefs fell more in line with the DEP than with deficit-based models of autistic mentalizing; the results indicated that both groups believed within-group mindreading (both when the respondent considered their mindreading ability and how readable they believed they were) was higher than inter-neurotype mindreading. They also found that beliefs about mindreading ability were affected by identifying as autistic. Nonautistic people assessed their mindreading ability as better overall (and themselves as easier to read), and the opposite was true for the autistic group. Despite the self-reported nature of the dataset, they note that these outcomes are revealing because beliefs relate to behaviors: beliefs about how one thinks they are perceived will impact how they interact and relate with members of the other group (p. 8). To conclude, there is an increasing volume of evidence that shows that the complex dynamics of social interactions and individual social experiences affect how autistic and neurotypical people struggle to form intersubjective understanding. More research is needed to discern how these misunderstandings can be accounted for and overcome, particularly in terms of improving mental health outcomes for people on the autism spectrum.

1.2.2 Autistic Intersubjectivity

Although studies focusing only on intra-group interactions in autistic populations are few, one study in this area took note of social and communicative approaches used by autistic people and how they may be misunderstood by nonautistic interlocutors. Heasman & Gillespie (2019) explored how autistic peers create mutual understanding between one another in joint interactions, primarily concerning coordination through language. Through observing autistic peers play video games together, they identified two distinctive features of autistic intersubjectivity: a generous assumption of common ground and a low demand for coordination. A generous assumption of common ground refers to the tendency

for autistic people to assume that the person they are speaking with shares knowledge or interest in some topic. They may refer to this topic without first verifying whether their partner is familiar with it, which may come across as incoherent or discordant, especially to nonautistic people. If the reference is understood, however, this change in topic within a conversation can rapidly build rapport in autistic interactions where both members co-create a shared language and mutual understanding with one another. The second characteristic, a low demand for coordination, refers to how small misunderstandings are resolved between autistic people. These misunderstandings could arise if pragmatic or contextual elements of the interaction are misinterpreted, but in the case of inter-autistic conversations, they are not particularly consequential. Autistic participants showed a high tolerance for confusing turns in conversation, opting not to attempt to clarify or resolve the confusion, they often permit such statements to flow through the conversation, which can even evolve into parallel dialogue where both members discuss their respective topics in tandem.

Heasman & Gillespie (2019) explain that these characteristics are complementary to each other because the low demand for coordination enables a generous assumption of common ground not to disrupt the social interplay. These features demonstrate that autistic people utilize distinct strategies to identify with others and form relationships that may not be apparent to nonautistic peers. The authors propose that these features may be challenging for nonautistic people to interpret due to perceived irrelevance or incoherence. Indeed, these characteristics could be viewed as violations of the cooperative principle (Grice, 1975). The cooperative principle suggests that all communication serves as a transfer of information and for them to be effective, speech acts must be relevant, adequately informative (but not overly so), truthful, and clearly conveyed. It has previously been shown that autistic children don't pick up on certain violations of the cooperative principle (Surian et al., 1996). However, it has been noted that the cooperative principle may be too optimistic regarding how people actually communicate within the social context (for review, see Hadi, 2013). For those not on the autism spectrum, the conversational redirection is jarring and not typically taken as an attempt at forming a connection, and worse, it may be perceived as egotistical on the part of the autistic person, contributing to negative impressions. Lastly, this study does not support the notion that autistic people lack social motivation, emphasizing instead that their interactions take on a different quality when their peers have similar communicative styles. Deficient social

motivation has been suggested to underly some autistic social traits on account of altered neural reward pathways for social stimuli, as well as behavioral differences in maintaining and seeking out friendships (Chevallier et al., 2012). However, these accounts do not consider, on one hand, autistic sentiments that show that autistic people are interested in other people and in forming relationships. On the other hand, they do not consider interaction dynamics and social experiences. In other words, they fail to acknowledge that unconventional social engagement may be a consequence of how autistic people are misperceived and treated rather than a symptom (Milton, 2012; Jaswal & Akhtar, 2018, p. 12).

Taken together with findings comparing autistic and neurotypical intersubjective styles, these studies provide new evidence of how individuals with autism interact within and across neurotypes. In doing so, they show that social interaction is qualitatively different in autism; autistic social interaction is effective, it just does not conform to nonautistic social standards. Differences in interaction style in tandem with differences in participatory sense-making can explain how autistic and nonautistic people experience social and communicative failures. Heasman & Gillespie's (2019) study highlights significant differences in how autistic people approach the co-creation of shared meaning in terms of verbal communication, but more studies are needed to see how different interactive contexts may impact non-verbal coordination and interaction. Interactive differences are also important to consider from an empirical standpoint, as social cognition measures and diagnostics created by nonautistic researchers for nonautistic social norms may not be informative in examining autistic social cognition, and it is therefore unsurprising that autistic people do not perform well on such assessments (Davis & Crompton, 2021; Harrison et al., 2022). Heasman & Gillespie also suggest that the interactive context (e.g., activities like video gaming) may be a facilitating factor in autistic interactions (p. 919). It is therefore also worth examining whether the situational context facilitates cross-neurotype interactions, for example, that which occurs within music therapy.

1.3 Music Therapy for Autistic Children

Music Therapy (MT) is a therapeutic intervention that has a long history as a treatment option for autistic people and children and is designed with the aim of

"[transferring] the skills developed in music-based experiences to other areas of life by developing cognitive, motor, emotional, and learning skills" (Applewhite et al., 2022). For children with autism, music therapy may positively impact social and verbal language skills, as well as initiating behaviors and emotion regulation (Marquez-Garcia et al., 2022). MT approaches for children with autism are child-oriented and foster emotional and social expression through musical encounters wherein the child can experience turn-taking, social-emotional reciprocity, and social engagement without the need for language (Geretsegger et al., 2012; Carpente et al., 2022). By leveraging elements of music like rhythm, melody, and loudness, the therapist can cultivate moments of synchrony and musical and affective attunement between themself and the child in their mutually constructed, musical dialogue (Crawford et al., 2017, pp. 1, 7). The child gains the opportunity to express themselves and have those expressions validated through the therapist's dynamic musical response. The therapist recognizes the child's expressions as intentional and communicative and engages with them by mirroring, supplementing, or complementing them musically, thereby facilitating and encouraging interaction and new social or communicative behaviors (Geretsegger et al., 2015). In addition to fostering social-emotional and communicative developments, MT may also have multisystem effects owing to the promotion of motor skills, access to sensory stimulation, and musical training (Srinivasan & Bhat, 2013).

Whether MT leads to improvements in symptom severity is still not quite certain, with some studies unable to report significant differences between MT and enhanced standard care (Bieleninik et al., 2017). Although the mechanisms responsible for positive outcomes from MT remain unclear (Groessing et al., 2023 preprint), a systematic review of randomized controlled trials (RCTs) showed that MT has a moderate to large effect on social interaction, initiating behavior, and social-emotional reciprocity for autistic children (Geretsegger et al., 2014, p. 18). They observe, however, that these studies were prone to small sample sizes and utilized different types of music therapy, affecting the generalizability of MT outcomes. Still, various processes applied during MT may lead to beneficial effects. Imitation, for example, is associated with higher social engagement and joint attention from minimally verbal autistic children during sessions (Carpente et al., 2022). It is also notable that music on its own doesn't appear to be responsible for positive effects. Music listening, for instance, was shown to be less effective in reducing symptom severity in autistic children than MT, indicating that active musical interactions and/or

therapeutic processes are central to adaptive or behavioral changes (Raberyon, et al. 2020). Additionally, findings reveal that music therapy increases resilience for children with autism. Resilience refers to "positive adaptation despite experiences of significant adversity or trauma" (Luthar, 2015). Resilience-oriented research takes a neurodiversity perspective in understanding treatment options for autism, focusing on improving protective or resilience factors (e.g., factors that provide means for coping with adversity) rather than on reducing symptom severity. MT has been shown to improve resilience factors for children with autism, in particular, emotional expression and regulation, impulse control and goal-directed executive function, self-efficacy, and social relationship skills improved over the course of five months of weekly MT intervention (Blauth & Oldfield, 2022, p. 471). However, without a control intervention to compare MT to, it is difficult to determine whether the processes specific to MT rather than more general therapeutic processes were responsible for this effect.

Musical interaction may also benefit therapists during sessions by helping them to empathize or relate more with their clients (Schwantes & Hughes, 2022). In structured interviews with practicing music therapists, the authors observed that therapists believed music aided them in connecting with their clients, deconstructing interpersonal barriers, maintaining presence, and displaying empathy, even when it was difficult (p. 8). Although this study did not evaluate therapists' ability to relate to autistic people or children specifically, these findings suggest that music or musical interaction ameliorates some of the difficulties that therapists face when they hold sessions with clients with whom they struggle to relate. Perhaps developments achieved through musical interaction affect how therapists relate with autistic children in ways that are meaningful to them, leading to some of the positive outcomes associated with MT. If so, this demonstrates that musical interaction may be useful to bypass some of the interpersonal hurdles presented by the DEP for therapists and autistic children alike.

Joint attention broadly refers to the capacity to mutually attend to the same object or event as another person, although it is a broad concept that encompasses several abilities that relate to the overall construct, such as responding to or initiating bids for joint attention. Joint attention has been implicated in language development by virtue of its role in helping infants acquire symbolic associations for referents in the world. Because language difficulties are rather ubiquitous in autistic children, Bottema-Beutel (2016)

conducted a meta-analysis examining autistic children's language and joint attention capacities, finding that there is a strong association between these abilities that is more pronounced than for nonautistic children. She notes that "facilitating joint attention is a useful intervention framework for promoting developmentally downstream language" (p. 1032). Therefore, therapeutic interventions that provide and reinforce moments of joint attention, e.g., musical intervention, may also improve language ability for autistic children.

Due to coordinative differences (De Jaegher, 2013; Trevarthen & Delafield-Butt, 2013) and diminished ability to imitate vitality forms (Rochat & Gallese, 2022) autism may involve differences in interactional synchronicity. Interactional synchronicity refers to a form of communication enabled by the temporal coordination of behaviors between the caregiver and infant through the creation and sensitive awareness of a shared rhythmicity (Trevarthen, 2017 cf., Nielsen & Holck, 2020). MT may be an appropriate intervention to introduce and facilitate interactional synchronicity (and thereby moments of intersubjectivity) as it has been found to be achieved during MT sessions, according to Nielsen & Holck (2020). A potential mediating factor for this outcome is the salience of rhythm imparted by the musical interaction. Rhythmic entrainment, for example, may facilitate motor synchronization and interpersonal coordination and shared affective experiences (Bharathi et al., 2019). It is possible that these experiences may enhance the "cognitive, social, and communicative potential to respond socially and individually" (Trost et al., 2017). This is important, because disordered embodied intersubjectivity on account of sensorimotor and contextual processing differences is a primary issue relating to autistic intersubjectivity according to Fuchs (2015). He notes that atypical mutual incorporation decreases the salience of social stimuli, as they are particularly bound to global perception, sensorimotor, and imitative and attunement processes (p. 197).

The musical interaction that takes place during MT is an ensemble that is inherently dyadic and mutual as the therapist and child co-create the musical element guided by the therapist's expertise and the therapeutic goals (Spiro & Himberg, 2016). According to Schiavo & De Jaegher (2017) musical interactions, whether all interactors are actively creating music or if some only observe, are coupled systems where intention and meaning are co-created. They argue that the 'musical object' is an emergent phenomenon arising from the shared engagement of each sense-maker in the musical activity that shapes and

is shaped by their coordination and mutual intentionality (pp. 3-4). In enactive music cognition, the relationship between the musical subjects and the musical object can be explained by the pre-conceptual and pre-linguistic features of music cognition by way of motor knowledge and bodily experience (Matyja & Schiavo, 2013, pp. 352-355). Because the musical object can refer to many aspects of the session including not only observable events but also to the inner, affective states of clients, it may act as a relational conduit for the therapist and autistic child to form moments of intersubjective relating and foster interaction through musical means (Mössler et al., 2020). In the following sections, we will consider the role of affect attunement in MT to clarify its benefit for children with autism.

1.3.1 Affect Attunement

To understand one another and form attachments, it is not only necessary for a caregiver to predict the physical needs of their child, but to also perceive and attend to their emotional states. Critically, the caregiver must be able to form an inter-affective space and respond to the emotions of the child in a way that an infant can detect. Affect attunement, as described by Stern (1985) refers to an intersubjective interplay in which a caregiver interprets the affective content of an infant's expression and reproduces that expression in a different modality thereby "expressing the quality of feeling a shared affect state" (p. 142). He emphasizes that the cross-modal aspect of attunements is essential because simple imitation would not permit the reference to an internal state. Cross-modal correspondences are identified by infants through analogous transposition of expression. Attunement behaviors center around the emotional state that coincides with the infant's expression, and through attunement, the infant can develop a sense of subjective self and begin to understand their own emotions and bodily states. The question then is, how does the caregiver achieve this? The manner through which the parent relays the expression to the child is through dynamic vitality forms (Stern, 1985). Take, for example, a child shrieking with delight upon fitting a geometric block through the correct hole in a toy, followed by the caregiver reacting by emphatically and exuberantly shaking their hands in the air and smiling. This is an example of a cross-modal correspondence, where the caregiver reiterates the expression of the child physically rather than vocally, but the *how* of the original expression is intact, through *form*, *intensity,* and *timing*, elements Stern

refers to as vitality forms. Vitality forms are dynamic elements of an action or expression where the manner of an action and possible intentions or feelings attached to it, are intuitively understood in language. Take the following example:

Ex. 1: "She _____ threw the ball"
→ gently, forcefully, half-heartedly, suddenly, deftly, smoothly, effortfully. . .

Each possible adverb conveys a different sense of how the ball is thrown, in addition to the potential motivation or attitude of the subject. In the case of music, vitality forms are not physical but emotive through sound and give forth a mental sense of "movement" and critically, they are shareable between people (Stern, 2010). In sum, affect attunement permits a phenomenological state of "being together with" the child in a way that helps them realize their sense of self and develop early intersubjective capacities.

In the case of autism, attunement processes during early development may not be as successful in helping the child develop a sense of autonomy and social-relational skills. One potential explanation for this is that autistic infants (<6 months) do not exhibit the same attentional patterns for social stimuli that nonautistic infants do. Attuning behaviors were one of many social stimuli (in addition to looking and orienting to people, vocalizing, and seeking contact) that were less frequently attended to by autistic infants (Maestro et al., 2002). These early attentional differences may have significant downstream effects on social development and social ability. Other evidence suggests that autistic children may not be as adept at matching vitality forms, because while they can replicate an action, they tend not to reproduce the *how* of the action (Hobson & Lee, 1999 cf. De Jaegher, 2013). Owing to perceptual and embodiment differences in autism, attunement processes may also be impaired in early life by dysfunctional sensorimotor and limbic neural structures, which impact relational and communicative abilities (Rochat & Gallese, 2022 p. 40). They posit that asymmetric attunement during infancy consequently impedes the social abilities of autistic people in later stages of life. However, other elements of caregiver interactions may further influence attunement differences.

Affect attunement is an important topic in attachment literature as it is a key factor in early child-caregiver interactions. Attuned parenting is an important aspect of social development and social competence, as intersubjective exchanges with parents inform future social behavior. However, a parent's acceptance of a child's autism diagnosis, in conjunction with their insightfulness to the child's perspective, is associated with their

attunement to the child during play (Di Renzo et al., 2020). Parents with unresolved feelings about their child's diagnosis or parents who were inept to understand or relate with their child's internal states were more likely to inadequately share and regulate the child's moods, engage in play with the child, or have an active presence that complemented the child's play (p. 6). Early instances of failed attunement are critical in the development of self for all children and could result in insecure attachment styles in future relationships (Kossak, 2021) and may be disproportionately likely for autistic children if parents are not able to attune with them.

The musical attunement that takes place during MT is not unlike caregiver-infant affect attunement; musical interactions may be analogous to real-life interactions where experiences are shared and co-created by the therapist-client dyad without necessitating verbal communication. In the way that affect attunement helps an infant construct a subjective self, musical attunement may also contribute to such developments for clients because it provides a nonverbal analogy for real-life intersubjectivity and a place for experiences to be shared (Trondalen & Skåderud, 2007). For therapists to successfully help clients address their needs, concerns, or goals, they must connect emotionally with them and be able to "put themselves in their shoes." Here, attunement is a central instrument for relating with the client and helping them make sense of their emotional or internal states. Yet, the ability to attune to them may be impacted by their backgrounds and characteristics. For instance, therapists' attunement, as observed through their responses to clients' concerns, was found to correspond with their attachment styles (Talia et al., 2020). Seligman (2020) notes that Stern's concept of affect attunement is not a mere reproduction of a pre-existing meaning; rather, it is a "transactional process through which both particular meanings and the general sense of meaningful, vital intersubjectivity are co-created, organized, and established. [It is] both intra-psychic and interpersonal, a dynamic process in which the infant can mean something to someone else, who in turn influences his/her experience through attending and reacting to it" (p. 25). Social interactions are therefore colored by a plethora of differences among interactors, and it may be difficult for therapists to understand another's experience without viewing it through the lens of their own experiences. So, despite the atypical perception of vitality forms and social attention in autism, caregivers and therapists may also contribute to attunement breakdowns. Recent work by Mössler et al. (2023) also explored the effect of the environment in MT interactions on attunement. They demonstrated that the conditions of

the therapy environment differently affect the therapist and non-autistic child which influences how attunement processes are navigated. In the case they highlighted, they found that the tension of a messy classroom environment impacted both interactors differently, where the child was able to exhibit creative and intentional interactive overtures despite the therapist's uncertainty about how to engage the child within a classroom setting. These findings speak to the often-overlooked influence of the ecological setting on interpersonal relating while also acknowledging the bi-directional nature of affective intersubjectivity.

Attunement literature aligns well with the enactive perspective because attunement is an intersubjective experience that leverages embodied understanding. As Fuchs and De Jaegher (2009) claim, "mutual incorporation and participatory sense-making can provide insight into another's experience, even if the other has no verbal abilities [… and that] we participate with the other in the emergence and transformation of intentions, affects, and understandings" (p. 482). One notable departure between these theories is pointed out by Mühlhoff (2014). He reframes affect attunement as *affective resonance,* a "processes of social interaction whose progression is dynamically shaped in an entanglement of moving and being-moved, affecting and being-affected [and that] in resonance, the interactant's behaviors and affective experiences may not necessarily resemble each other, but yet they are a jointly created dynamic, shaped within the relational interplay" (pp. 1001-1002). According to him, Stern's account of affect attunement is paradigmatically individualistic – a transfer of feeling states, rather than a mutual creation thereof – and does not describe the full depth of the interaction dynamic and how it constitutes an affective quality that does not exist before the interaction (p. 1015).

In addition to musical attunement, there are several other interactive and intersubjective dynamics within the context of music therapy that may have meaningful effects for autistic children following intervention. Musical interaction necessitates multiple forms of coordinated and intentional actions, including turn-taking, joint attention, synchronicity and mutual improvisation. Stern's (1985) focus on attunement covered only the affective property of intersubjective relating; he noted that joint attention and joint intention were further necessary components for full intersubjectivity. Intersubjectivity requires timing and rhythm to generate communicative musicality (Trevarthen & Malloch, 2001). Communicative musicality refers to the capacity for a

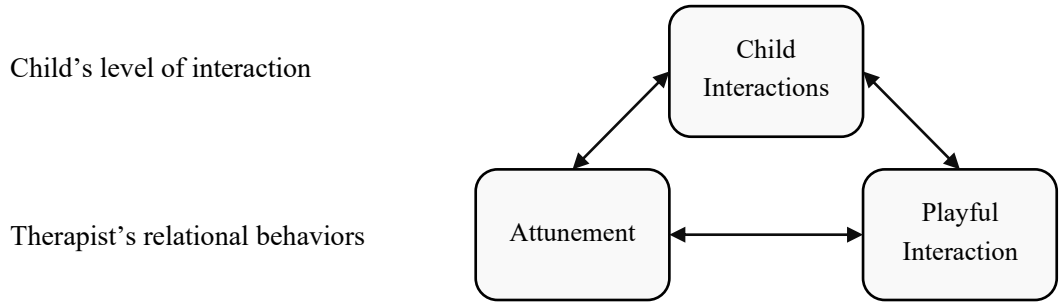
caregiver to resonate and coordinate with the infant's gestural and vocal expressions by means of pulse and pitch-contour (e.g., prosody of child-directed speech), not to mention the ongoing, co-created sequence of expressions though these means (pp. 6-9). In a similar manner as attunement, this type of intersubjective relating enables a communicative quality in infant-caregiver interactions that does not require language. While it can be tapped into for emotional relation in the dyad, it primarily refers to the dynamic, coordinative and aesthetic elements that provide structure for early intersubjective interaction.

1.4 Problem Statement and Research Questions

The current thesis will examine the jointly created dynamics between the autistic child and neurotypical therapist in music therapy with consideration for mismatch in neurotype. We will investigate whether the therapist's playful interaction (the therapist's thoughtful engagement in play with the child) and affect attunement influences how the child interacts with the therapist in turn. Whether the child's interactive behaviors influence the therapist's levels of attunement and playful interaction will also be examined. In this vein, we will also determine whether therapist's relational behaviors, attunement and playful interaction, are associated with one another. These questions make up the first over-arching research question and are illustrated in Fig. 1:

1. Are the child's level of interaction, the therapist's affect attunement, and the therapist's playful interaction associated with one another?
    a. Is the child's level of interaction related to the therapist's playful interaction?
    b. Is the child's level of interaction related to the therapist's attunement?
    c. Is there a relationship between the therapist's playful interaction and attunement?

Figure 1: Potential associations between variables



Potential relationships between variables of interest between an autistic child and nonautistic music therapist during sessions represented by arrows.

In addition to examining whether these aspects of the interaction are connected on a general level, we will be investigating the effect of musical intervention on the relationships between therapist and child behaviors in comparison to a non-musical interaction, play therapy. Here, we are interested in determining whether music influences or facilitates any of these associations. The final factor of interest is the role of familiarity and whether the relationships between the therapist's playful interaction and attunement and the child's interaction change as a mutual history develops within the context of the therapeutic environment. The remaining research questions can be summarized as follows:

2. Does a musical intervention impact the relationships between the therapist's interactive and relational behaviors and the child's interaction?
3. Does the number of sessions (reflecting the development of a therapeutic relationship) influence the relationships between the therapist's playful interaction and attunement and the child's level of interaction?

Because of the asymmetric nature of this kind of relationship, which involves a child (client) and adult (therapist) we will not be able to draw inferences about inter-neurotype intersubjectivity on a broader scale. The generalizability of the results is also restricted to the therapeutic context and will therefore not apply to other types of dyadic relationships. However, the goal is to determine whether the therapists' relational and interactive actions are related to the interactive behaviors of autistic children during musical and play-based interventions. We anticipate that each of the association pairs as depicted in Fig. 1 will positively covary on account of reciprocal interaction processes during sessions. For instance, we hypothesize that the therapist's attunement might prompt some form of social

interaction from the child or vice versa depending on the ongoing interpersonal context of the therapeutic activity. Whether these social interactions are cooperative, coordinated, and friendly will determine the strength of the correlation. To this point, we expect that Attunement and Child Interactions as well as Playful Interaction and Child Interactions to have a moderate correlation. Attunement and Playful Interaction will likely also be moderately to highly correlated as they both involve recognition and awareness of the child's needs. Furthermore, we anticipate higher correlations for each association pair in the MT condition compared to PT, as we expect that the musical interaction will facilitate coordination and participatory sense-making between the therapist and child. Lastly, we predict that the therapist's relational behaviors will maintain a steady correlation over time for both interventions, while the child's level of interaction with these behaviors is more likely to fluctuate as the child becomes more comfortable and familiar with the therapist and the intervention setting.

2. Methods

The present thesis was conducted within the Music for Autism (M4A) project, an assessor blinded, Randomized-Controlled Trial (RCT) study. M4A replicates and expands upon a previous study by Sharda et al. (2018) that examined the behavioral and functional brain connectivity changes brought about by 12 weeks of music therapy (MT) in autistic children compared to a non-musical intervention, play therapy (PT). The M4A project is a binational study recruiting participants in both Bergen, Norway, and Vienna, Austria. It includes additional psychometric and biological measures that will assess various effects of MT in addition to those applied by Sharda et al. One element of the M4A project is the use of treatment fidelity assessment and monitoring. The aim of treatment fidelity is to ensure that the intervention is implemented as intended by the research team, which helps to ensure the validity of the results of a study (Sanetti et al., 2021). The treatment fidelity checklist encompasses several components of the sessions including structure, content, therapeutic processes, and aspects of the child's behavior. Data for the present study comes from treatment fidelity ratings described in detail in section 2.3.

2.1 Participants

Children included in the study were between 6 to 12 years of age and diagnosed with autism by a licensed clinician with an ICD code (World Health Organization, 2018). Potential participants were excluded if they were unable to undergo fMRI measurements due to metal implants, conditions like claustrophobia, or an inability to lie still during scanning. Further exclusion criteria included long-term musical training (>12 months) or participation in individual MT in the 6 months before recruitment (see Ruiz et al., 2023 for review). Although the M4A project had not yet reached the end of data collection, data for 68 participants (50 Vienna, 18 Bergen) were obtained at the time of analysis. Twelve participants were female, representing 17.6% of the sample, or a male-to-female ratio of 4.6:1. This is consistent with a previous meta-analysis that indicated a similar ratio of 4:1, although it is suspected that the true proportion of boys to girls is likely closer to 3:1 (Loomes et al., 2017). Even though it is not unlikely that the ratio presented in this thesis is not entirely representative of the autistic population in terms of gender, it aligns well with recent studies, especially given that the current diagnostic instruments are not well-adapted for detecting autistic characteristics in girls (Gould, 2017).

Table 1: Demographic Data

	Bergen *(n = 18)*	Vienna *(n = 50)*	Total *(n = 68)*
Gender			
Male	12	44	56
Female	6	6	12
Age			
Mean (SD)	8.83 (2.31)	8.66 (1.83)	8.71 (1.95)

n = number of participants; SD = Standard deviation

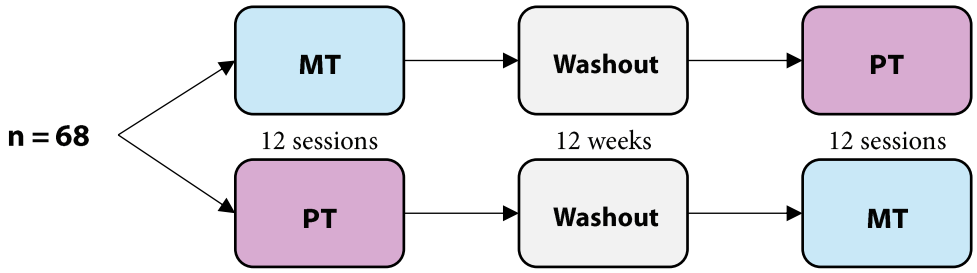
The M4A project employed a total of 13 music therapists (6 in Bergen and 7 in Vienna) certified to practice music therapy in their respective countries. None of the music therapists had received an autism diagnosis. Therapists were responsible for conducting both MT and PT interventions for each child they worked with, except in rare instances where schedules conflicted. In these cases, the second intervention would be carried out by another music therapist. All therapists obtained training on the treatment fidelity manual

prior to beginning therapy sessions with the children and attended biweekly supervision meetings for the duration of their employment in the project.

2.2 Interventions

After recruitment, each participant was randomly allocated to individual music therapy or play therapy for 12 sessions, followed by a 3-month washout period. After the washout period, participants received the other intervention for 12 sessions. MT and PT interventions followed the same overall structure and were differentiated only by the musical components in MT.

Figure 2: Participant allocation to interventions



n = number of participants

Music therapy included the use of songs, musical instruments, and rhythmic cues among other musical elements to facilitate nonverbal modes of communication, creativity, joint musical attention, synchrony, and musical attunement. Similarly, play therapy was an active and engaging therapeutic intervention that utilized toys and verbal communication and controlled for factors such as encouragement and attention from the therapist, emotional support, and positive experiences. Each session aimed for a duration of approximately 45 minutes and followed the general structure of Hello → Activity 1 → Activity 2 → Activity 3 → Activity 4 → Goodbye. In the PT condition, the therapist greeted the child and said goodbye verbally, whereas MT utilized Hello and Goodbye songs. At the beginning of each session, children were asked to indicate which activities they wanted to complete with the use of visual schedules to aid communication. In either intervention, children were given the opportunity to choose four from the following activities:

Music therapy: Piano, Djembe, Kalimba, Musical Book, Boomwhackers, Bear bells, Flute, Microphone, Ukelele, Xylophone, Kazoo, and Eggshakers

Play therapy: Connect Four (Four in a Row), Halli-Galli, Darts, Bubbles, Non-musical Book, Play-doh, Slime, Lego, Puzzle, Bean bags, Finger puppets, and Jenga.

At some point during the therapy session, typically at the beginning and/or end, the children were also asked to indicate their mood using a visual support. When the therapy session concluded, therapists summarized the events of the session and completed a treatment fidelity checklist. This was used to ensure that therapists were mindful of implementing the treatment fidelity manual during their sessions.

2.3 Design

In addition to therapists' treatment fidelity forms and biweekly supervision meetings, treatment fidelity was primarily assured through ratings of video-recorded therapy sessions. Sessions from the beginning, middle, and end of each intervention were coded by two independent raters trained on the treatment fidelity manual. Recordings from the first, sixth, and twelfth sessions were used for ratings as much as possible, except in cases where the video was not viewable, or the child could not be seen on camera. When this occurred, the next available session was used in place of the unratable video. Approximately 4 data points were obtained from each video recording, based on the number of activities completed during the session. In some cases, a preoccupation with one activity over another would leave no time remaining for a final activity, or more than four activities were completed during the session. In these cases, fewer or more data points were available for analysis for that given session. To investigate the present research questions, we used data collected through treatment fidelity ratings, focusing on therapists' interactive and relational behaviors as well as the child's interaction.

2.3.1 Measures

The treatment fidelity checklist comprised several components of the intervention which included general information about the session (e.g., activities and their duration,

the overall session length whether all aspects of the checklist were implemented) as well as the therapeutic process variables and some elements of the child's behavior. The present analysis used the following variables from the treatment fidelity rating data:

Attunement (ATT) refers to how frequently the therapist attends to the child's emotional expressions and interests and their dynamic affective and musical response. When attunement is high, therapists maintain a careful awareness of the child's emotional states, interests, and communicative efforts and respond to them in a manner that reframes, reflects, or reinforces the child's contribution. In music therapy, the therapist takes advantage of musical elements such as rhythm and melody to attune to the child's expressions in a dialogic manner, communicating to the child that their emotions and perspectives are recognized and validated (Ruiz et al., 2024). For each activity, attunement was rated from 0 (never or almost never) to 3 (always or almost always) to account for how consistently the therapist was attuned to the child.

Playful interaction (PI) is a measure of the therapist's engagement in joint play with the child where the therapist meets the child where they are at in play and adjusts their behavior accordingly. It refers to the therapist's thoughtful and deliberate participation in the child's play depending on their needs/wants. This could involve a range of interactions with the child from leading an activity, actively engaging in play, or simply being present and observing. By bringing together a playful atmosphere and attuning emotionally to the child, the therapist creates an environment that encourages and validates the child's self-expression. Playful interaction was rated from 0 (never or almost never) to 3 (always or almost always) for each completed activity.

Child interactions (CI) refers to the child's level of interaction with the therapist. This could include several types of interaction, including verbal communication, joint attention, turn-taking, engagement in eye contact, and physical touch. As with the other measures, the frequency of all child interactions was rated from 0 (never or almost never) to 3 (always or almost always) for each activity.

2.4 Data Analysis

Data for participants with incomplete ratings at the time of analysis (e.g., only 1 rater) were excluded. As a result of withdrawal from the study during the washout period or ongoing participation, the total number of participants for each intervention was unequal. 68 participants completed MT, while the total number of participants for PT was 66. Many participants were unable to attend all 12 weeks of therapy, resulting in a mean number of sessions of 11.20 for MT and 11.23 for PT. A further 3 participants discontinued music therapy while the intervention was in progress. In these cases, there is no second or final video-recorded session to rate (totaling 4 missing sessions), but the data for the available sessions were kept for analysis. For the present analysis, sessions were coded as timepoints T1, T2, and T3 to indicate the beginning, middle, and end of the intervention, respectively. Inter-rater reliability for attunement, playful interaction, and child interaction was calculated before further statistical analysis. Both raters' treatment fidelity ratings for attunement, playful interaction, and child interaction were averaged into a single rating for each data point for the respective variables and bivariate correlation analyses were used to determine the associations between each of the variables of interest. Then, the same analyses were conducted for MT and PT separately, and the resulting correlation coefficients were compared to determine whether there were any differences between intervention types. Lastly, these associations were examined for both music and play therapy at the beginning, middle, and end of each intervention to evaluate whether any changes occurred as the therapist and child developed a shared history of jointly created experiences.

3. Results

Statistical analyses were performed in R 4.4.1 (R Core Team, 2021), utilizing the psych (Revelle, 2024), ggplot2 (Wickham, 2016) and ggpubr (Kassambara, 2023) packages. Inter-rater reliability was calculated using an intra-class correlation with a two-way random effects model and single measurement, ICC (2,1) (Shrout & Fleiss, 1979; Koo & Li, 2016). Intra-class correlation coefficients for each variable were low (Attunement ICC = 0.250 [0.200, 0.299], Playful Interaction ICC = 0.329 [0.282, 0.376], Child Interaction ICC = 0.232 [0.171, 0.289]). Because none of the correlation coefficients fell above 0.50, inter-rater reliability was considered poor (Koo & Li, 2016). To account for

low reliability and differences in raters' scores, the mean of both ratings for each activity was used for statistical analysis.

Table 2: Mean Ratings

	Attunement	Playful Interaction	Child Interaction
MT	2.76 (0.36)	2.69 (0.52)	2.60 (0.50)
PT	2.71 (0.43)	2.74 (0.47)	2.67 (0.46)
Total	2.74 (0.40)	2.72 (0.49)	2.64 (0.48)

Figures within parentheses are standard deviations

Mean overall ratings for attunement, playful interaction, and child interaction were high, indicating therapists' good adherence to the treatment fidelity manual and relatively high engagement from the children with the therapist during therapy sessions. Average attunement ratings were marginally higher in MT than in PT, while average playful interaction and child interaction ratings were lower. A two-sample T-test was conducted for each variable to test whether the true difference between them in MT and PT groups was statistically significant. Assuming a confidence interval of 95% (α =0.05), we were able to reject the null hypotheses that there were no differences in these variables between MT and PT. Significant differences were observed between MT and PT in terms of attunement ($p = 0.029$), playful interaction ($p = 0.046$), and child interaction ($p = 0.009$).

3.1 Initial Correlational Analysis

To determine whether attunement, playful interaction, and child interactions are associated with each other, bivariate correlation analyses were conducted for each variable pair (ATT and PI, PI and CI, and ATT and CI). From an initial visual inspection of the data in Normal Q-Q plots, we were unable to verify that it was normally distributed. We consequently performed Shapiro-Wilk normality tests and confirmed that the data do not follow a normal distribution, ruling out methods that rely upon the assumption of normality. Therefore, we utilized Spearman's Rank correlational analysis to determine the relationships between the therapist's relational behaviors and the child's level of interaction.

Table 3: Overall correlation between variables

Variable	1	2	3
1. Attunement	1		
2. Playful Interaction	0.43	1	
3. Child Interactions	0.44	0.50	1

All correlation coefficients are statistically significant ($p < .05$).

Correlation coefficients for each variable pair indicate that they are all moderately positively associated. PI and CI are the most highly correlated variables in the general dataset, while the other variable pairs show similar, but lower correlative tendencies. Although the relationship between variables is not monotonic, there is a trend for the variables to increase in tandem, indicating that higher attunement is associated with higher playful interactions and so on (Schober et al. 2018). Each of the correlations was determined to be statistically significant with two-tailed $p < 0.001$ for each variable pair. Having determined the general associations between each of these variables, we can continue with their comparison in the MT and PT conditions.

3.2 Comparison between Music and Play Therapy

To test if the associations between each variable were different in the musical versus play-based interventions, we calculated the same correlation pairs for MT and PT individually. Having already determined that MT and PT groups were significantly different in section 3.0, we proceeded with Shapiro-Wilk tests to verify whether the distribution for both MT and PT subgroups was normal. However, these resulted in extremely low p-values, indicating that nonparametric testing was still appropriate. Notably, the relationship between playful interaction and attunement was lower in PT compared to MT, while the other correlations were more closely matched across intervention groups (see Fig. 3).

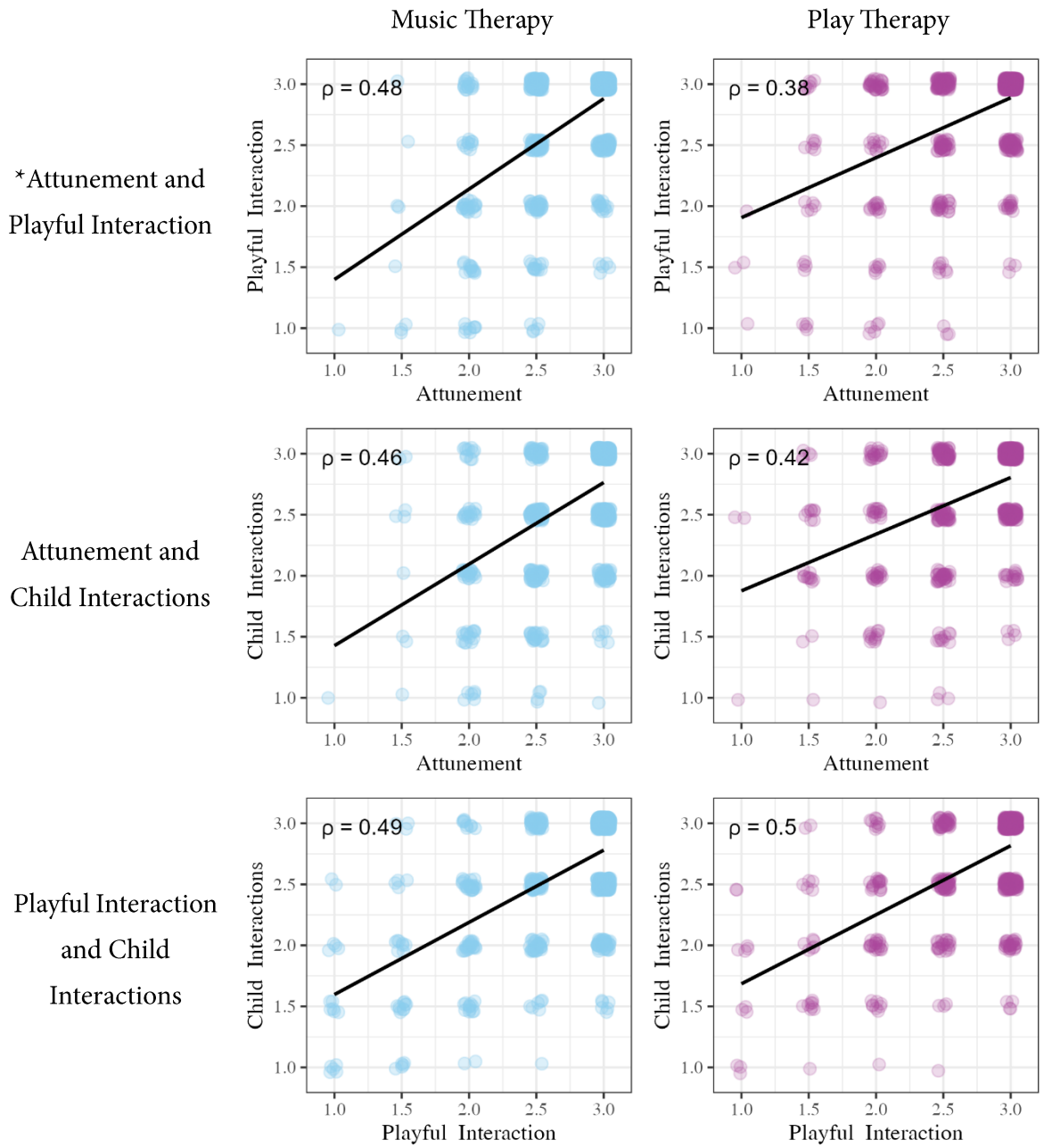
Table 4: Correlation between variables by intervention

Group	Variable	1	2	3
MT	1. Attunement	1		
	2. Playful Interaction	0.48	1	
	3. Child Interactions	0.46	0.49	1
PT	1. Attunement	1		
	2. Playful Interaction	0.38	1	
	3. Child Interactions	0.42	0.50	1

All correlation coefficients are statistically significant ($p < .05$).

The Fisher *z*-transformation results in a value that would occur within an approximately normal distribution, enabling the comparison between correlation coefficients (Fisher, 1973, p. 184; Meng et al., 1992). Although Fisher's *z*-transformation is typically used in cases where the data are parametric and Pearson's r is calculated, it has also been shown to be suitable for comparing Spearman's rho (ρ) correlation coefficients (Myers & Sirois, 2006). By transforming ρ to *z* following this method, we can determine whether the associations of interest are significantly different in MT compared to PT. The correlation between the therapist's relational variables, ATT and PI, was shown to be significantly different between both groups ($Z = 2.29$, $p = 0.02$), with a higher correlation observed for the MT condition. Associations between the other two correlation pairs were not shown to be statistically different in MT and PT – the correlation between ATT and CI yieleded a p-value of 0.43 ($Z = 0.79$), and the correlation between child interaction and playful interaction resulted in a p-value of 0.67 ($Z = -0.43$).

Figure 3: Correlations by intervention



Correlations between each variable pair for MT (left) and PT (right). A slight jitter was introduced to better visualize the distribution of the covariation between variables. A statistically significant difference was observed between MT and PT for correlations marked with asterisks (*).

3.3 Change in Association over Time

We performed a final round of bivariate correlational analyses to assess if any changes occurred in the relationships between variables over the course of each therapeutic

intervention. MT and PT subgroups from the previous section were further subdivided into three groups for each time point: T1, T2, or T3 (first, middle, and final session, respectively). Shapiro-Wilk normality testing again indicated that subgroups were non-normally distributed, calling for continued use of the Spearman's Rank method to measure the correlation between the variables in each pair.

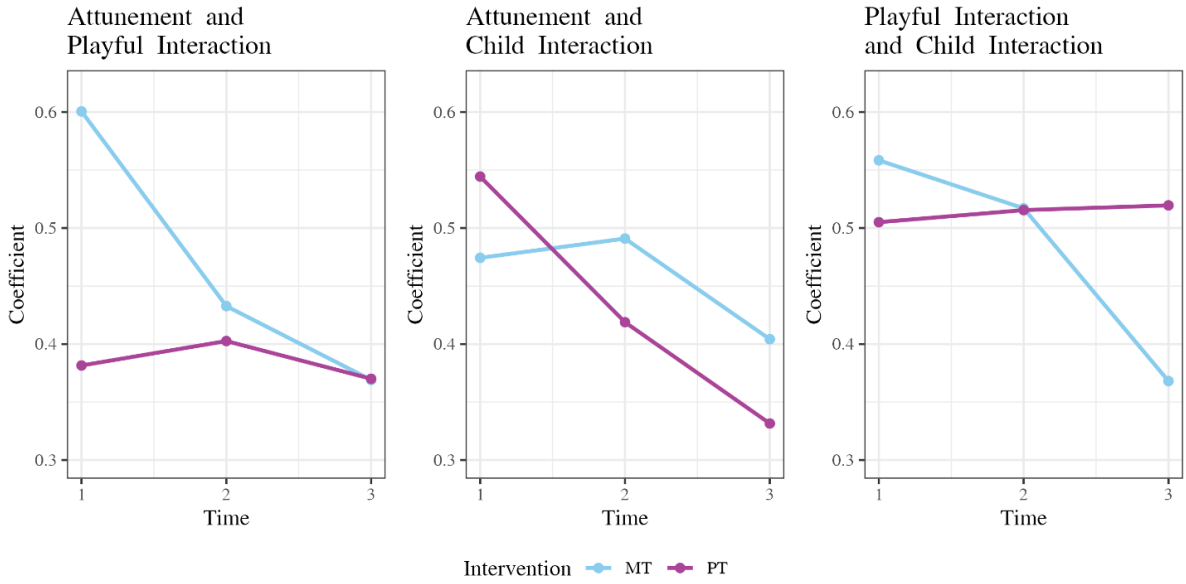
Table 5: Correlation between variables by intervention at time points

Time		T1			T2			T3		
Group	Variable	1	2	3	1	2	3	1	2	3
MT	1. Attunement	1			1			1		
	2. Playful Interaction	0.60	1		0.49	1		0.40	1	
	3. Child Interactions	0.47	0.56	1	0.43	0.52	1	0.37	0.37	1
PT	1. Attunement	1			1			1		
	2. Playful Interaction	0.38	1		0.42	1		0.33	1	
	3. Child Interactions	0.54	0.50	1	0.40	0.51	1	0.37	0.52	1

All correlation coefficients are statistically significant (Bonferroni corrected α, *$p < .008$).*

Because of the large number of statistical tests conducted, a Bonferroni adjustment was made to account for potential type I errors that could result from multiple hypothesis testing. To account for the conservative nature of the Bonferroni method, α was divided by the number of tests per hypothesis (refer to page 29, bullet points a, b, and c) rather than the overall number of tests – $\frac{0.05}{6} = 0.008$. Controlling the familywise error rate in this way allowed us to preserve statistical power while controlling for false positives and is a justified approach when dealing with multiple research questions or hypotheses (Bender & Lange, 2001). The correlations for each variable pair, in either the PT or MT condition, were shown to be statistically significant given the adjusted α ($p < 0.008$) at each time point, allowing us to reject the null hypotheses that these bivariate variable pairs do not correlate at each respective time point. Interestingly, the strength of the association between the variables for most correlations tended to be highest in the first session and weakened over time. In PT, however, two correlation pairs showed more stability throughout the intervention, including the association between ATT and PI and the relationship between PI and CI (see Fig. 4).

Figure 4: Correlations over time



Graphical representation of the change in correlation over time for each variable pair for both intervention types using line plots.

To determine whether the change in correlation between each time point was significant, we once again employed the Fisher *z*-transformation to compare changes between the first and middle (T1-T2), middle and last (T2-T3), and first and last (T1-T3) sessions using the correlation coefficients for each variable pair in both interventions. This entailed a further 18 statistical tests, so we accounted for another Bonferroni adjustment for the level of confidence. Because the initial calculation of correlation coefficients was a necessary, preliminary step to perform the current tests, that involve different hypotheses (namely the comparisons between two time points rather than a correlation calculation) we are treating this set of tests as separate for the purpose of calculating α. We again consider each hypothesis tested as separate in this case, resulting in $\alpha = 0.008$.

We were able to conclude that there are significant ($p < 0.008$) differences in the associations between ATT and PI as well as PI and CI in MT. These relationships exhibit a statistically significant decrease in correlation from the beginning to the end of the twelve weeks of therapy sessions. If we were to assume $\alpha = 0.05$, we might also determine that there is a significant difference between T1 and T2 for ATT and PI, indicating that the decrease in the correlation between these two variables is the most significant within the first six weeks. A similar claim could be made for PI and CI for the period from T2 to T3,

suggesting that the decline in this correlation is more significant in the last six weeks. However, due to the Bonferroni adjusted confidence interval, these claims must be interpreted with caution. A significant decrease was also seen between ATT and CI in PT from the beginning to the end of the intervention. In contrast, the correlation between these variables remained relatively steady during MT.

Table 6: P-values for correlational changes over time

Group	Variable	T1-T2	T2-T3	T1-T3
MT	Attunement & Playful Interaction	0.01*	0.41	0.00071**
	Attunement, Child Interaction	0.81	0.24	0.33
	Playful Interaction, Child Interaction	0.52	0.044*	0.0069**
PT	Attunement & Playful Interaction	0.79	0.69	0.89
	Attunement, Child Interaction	0.085	0.288	0.0057**
	Playful Interaction, Child Interaction	0.88	0.95	0.838

** Statistically significant $p < 0.05$, **Statistically significant with Bonferroni corrected* α, $p < .008$. *Refer to Appendix C for Z-scores.*

3.3.1 Individual Variable Change over Time

A remaining point of consideration was whether any of the individual variables exhibited a significant change over time that may have influenced the correlational changes. To see if fluctuations were present in one variable and if that could provide context for the changes in the correlations we observed, a post hoc analysis was conducted. We tested whether the central tendency for Attunement, Playful Interaction, or Child Interactions changed significantly over the course of either intervention. After calculating the mean rating for all variables in both interventions at each time point (see Table 7), we compared each of the mean ratings from T1-T2, T2-T3, and T1-T3 in MT and PT using two-sample T-tests.

To account for the increased volume of statistical tests, we recalculated the Bonferroni adjusted α from the previous section for these tests, which resulted in $\alpha' = (\frac{0.008}{6}) = 0.0013$. Given this change in confidence level, we were not able to detect any significant differences over time for any of the variables in either intervention. However, we observed that if we had retained the conventional significance level ($\alpha = 0.05$), we would have one significant finding from this set of tests. Specifically, there was an increase

in the mean rating for Child interactions from T1-T3 in MT. Although we must interpret this finding cautiously, the t-test for this comparison resulted in a p-value of 0.018 (see Appendix D), suggesting that the increase between the first and last sessions in terms of Child interactions for MT may be a statistically significant change to bear in mind regarding the correlational changes over the course of MT.

Table 7: Variable means at each time point by intervention

Group	Variable	T1	T2	T3
MT	1. Attunement	2.74	2.75	2.79
	2. Playful Interaction	2.67	2.68	2.72
	3. Child Interactions*	2.55	2.59	2.66
PT	1. Attunement	2.75	2.68	2.70
	2. Playful Interaction	2.72	2.77	2.73
	3. Child Interactions	2.63	2.65	2.72

*Mean ratings in MT and PT at each time point. *Statistically significant increase from T1-T3.*

4. Discussion

The results of the first statistical analysis illustrate that the three variables in question, Playful Interaction, Attunement, and Child Interactions are all positively associated with one another to a moderate degree. The observed correlation for all pairs is indicative of mutual interaction processes between autistic children and music therapists in therapeutic settings where the therapist actively engages, validates, and supports the child. It is sensible that the associations between each pair are not more strongly correlated given the reciprocal and dynamic nature of dyadic relationships where misattunements or other interactive breakdowns might impact coordination and relating behaviors. These associations are also vulnerable to other environmental or individual factors that may impact the strength of the relationships. However, without conducting this investigation on matched-neurotype dyads, we cannot determine whether neurotype mismatch is a factor affecting the strength of the correlation in any of the bivariate analyses.

By comparing MT and PT we were able to investigate whether musical interaction affected any of the links between the therapist's and child's behaviors. No significant differences were found between MT and PT for PI and CI or ATT and CI. However, the

link between ATT and PI was found to be significantly higher in MT compared to PT. This suggests that in the musical intervention, therapists' attunement and playful interaction with the child were more likely to occur together than in PT. Therefore, MT may potentially enable or necessitate the therapist's consistent application of both attunement and playful interaction during music-based activities. In contrast, the association of these variables in PT was weaker, which may indicate that one therapeutic process was employed more or less frequently than the other during different activities. However, because correlations do not provide evidence about the causal link between variables, we cannot determine how they influence each other in the interventions. Both association pairs involving the child's level of interaction did not demonstrate significant variation between interventions. This may be because the child's level of interaction is independent regardless of the type of intervention or that the intervention type doesn't directly influence its association with the therapist's relational behaviors.

Finally, we investigated the effect of time on these associations in both music and play therapy. We found that each of the bivariate relationships tended to decrease by some degree over the course of either intervention although some associations remained relatively stable. Two association pairs exhibited a significant decrease in strength over time in MT. First, the magnitude of correlation between attunement and playful interaction displayed a considerable drop from the beginning to the end of the intervention that was not shown in PT. Because the p-value between the first and sixth (middle) sessions would be significant, if not for the doubt cast by multiple testing, we can cautiously interpret this early decrease in correlation. Here, it is possible that the first session of MT may stand out as a possible special case with respect to the remaining therapy sessions. In the first session, the child is introduced to the therapist and the therapeutic setting, but likely also to unfamiliar musical instruments for the first time. The newness of the situation and opportunity for novel experiences may have demanded additional awareness and presence in play from the therapist to help the child navigate or explore these previously inaccessible methods of expression. The second prominent change in MT was the decrease in the relationship between the child's interactions and therapist's playful interaction. Again, we can make a careful observation about the decrease for an interim period within the intervention. The association decreases markedly from T2 to T3, suggesting that it occurs once the child has spent more time with the therapist or became used to musical interaction. The post hoc test suggests that the level of interaction from the child was considerably

higher in the last session than in the first, which could indicate that the decrease in correlational strength over time was due to this change. The remaining association pair between attunement and child interactions exhibited a meaningful decrease from the beginning to the end of sessions in PT but not in MT. This suggests that therapists are consistently attuning to the child's affective states as their level of interaction increases in music therapy. Perhaps either the child's increase in interactions provides more opportunities for the therapist to attune with their emotions, or the consistent attunement in MT facilitates the uptick in the child's interactive behaviors. Because the relationships between these variables decrease significantly in PT, it reveals the consistent association between attunement and child interactions is enabled by the musical interaction. These results are likely affected by the change in interpersonal relationships between music therapists and children in conjunction with improved familiarity with the situational context of the therapeutic setting, involving both the environment and therapeutic routines. Together, these findings suggest that there are distinct transformational patterns in the interpersonal behaviors between music therapists and autistic children in musical and play-based interventions. Attunement, in particular, seems to be especially meaningful in music therapy because of its consistent association with the child's level of interaction over time and its distinguishable relationship with playful interaction compared to PT.

De Jaegher (2013) notes that interventions for autism need to pay specific attention to interactional coordination, rhythmic capacity, and participatory sense-making to support social-emotional, communicative, and sensory experiences (p. 13). On one hand, many of the ways that the therapist and child interact, independent of intervention type, rely upon dialogic or turn-taking dynamics where the child and therapist must negotiate and respond to each other spatially and temporally. Play therapy, for example, provides opportunities for these experiences because some of the activities are games that naturally involve turn-taking or can elicit periods of imaginative play where the therapist and child join each other in mutual, playful narratives. Play therapy activities could also support sensory needs by providing tactile and visual enrichment based on the child's needs. In comparison, music therapy can provide many of the same experiences through compositional and musical means where both therapist and child can cooperate with each other through the musical object. The child can access further haptic and aural sensory experiences that can be acknowledged by the therapist's augmentation of the musical expression. Importantly, moments of interpersonal synchrony, coordination, and emotional resonance can be

conveyed and co-created through musical interactions in a manner that may not be replicated in non-musical interpersonal experiences. As we have found that the relationship between attunement and child interactions is consistent over time in MT, it appears that music may enable the therapist to engage the child in affective participatory sense-making while also increasing the child's interactive opportunities.

4.1 Intersubjectivity, Autism, and Empathy

Human beings are born with an innate sense to form connections with others. This is evidenced by infancy studies that show, for example, that neonates and caregivers experience affective sharing through autonomic and motor mimicry (Prochazkova & Kret, 2017). Another perspective is that infants experience emotion contagion with other infants on account of underdeveloped self-other differentiation (Paulus, 2014). However, it is apparent that we have an inborn sense for sociality. It is also clear that being born with a different neurological and embodied make-up influences the way we relate with others. Sensorimotor and embodiment differences that present in autism may influence the way that autistic people engage with themselves, the environment, and others on a basic level. Early differences in perception and movement may therefore influence timing ability, affecting interactional synchrony and coordination, as well as the ability to replicate vitality forms (De Jaegher, 2013; Rochat & Gallese, 2022). According to the double empathy problem, however, this does not mean that autistic people encounter these problems with everyone. Evidence does suggest that autistic people can effectively interact and communicate with one another while social breakdowns occur across neurotypes (e.g., Crompton 2020b; Heasman & Gillespie, 2019). Although alignment in individual cognitive profiles tends to influence interpersonal synchrony, resulting in positive shared experiences, it depends upon inter-individual characteristics as well (Carnevali et al., 2024). Interactions are interdependent and are influenced by social norms, individual intentions, power dynamics and other social dispositions (Rusbult & van Lange, 2003) that will affect inter-neurotype participatory sense-making and mutual understanding. More research is needed on autistic and inter-neurotype interactions so that we may better understand how interpersonal breakdowns can be resolved (without simply attributing them to the autistic person's cognitive or affective differences).

We might also consider how empathy factors into inter-neurotype intersubjectivity. Indeed, Husserl's (1859-1938) original definition of intersubjectivity suggests that empathy facilitates the interchange of perspectives and feelings between people (Husserl, 1929/1935; Trevarthen & Aitken, 2001). Except for its use in the context of the DEP, the concept of empathy falls outside of the scope of this thesis and has been carefully avoided because of empirical and ethical concerns about its application in scientific literature, particularly with respect to autism. On a methodological level, the conceptualization and application of empathy in research is inconsistent insofar as there is little agreement about what empathy is, what it entails, and how to measure it. For instance, the term empathy has been used interchangeably with other cognitive processes such as Theory of Mind by some (e.g., Golan & Baron-Cohen, 2006), while others assert that ToM is a component of 'cognitive empathy' in an over-arching multimodal empathy construct that also includes affective processes (e.g., Harmsen, 2019). A recent systematic review by Bollen (2023a) evaluated studies on empathy and found that it was defined or operationalized in 31 conceptually different ways in autism research alone. I concur with her that without an unambiguous, un-diverging concept of empathy, we cannot make assertions about any individual's empathetic capabilities. And yet, lackadaisical claims about ToM and its conflation with empathy cast strong negative assertions about whether autistic people empathize with others.

This becomes all the more problematic when we consider that having empathy is frequently considered to be a characteristic of a moral person. Bollen (2023b) suggests that the predominant conceptualization of empathy is biased toward neurotypical expressions of the phenomenon, effectively gatekeeping the concept from those who are neurodivergent. In her efforts to clarify the prerequisites for a fairer conceptualization of empathy, she states that "rather than focusing on an individual level, research on empathy in inter-neurotype interaction, and factors that facilitate or disturb this, is needed" (Bollen, 2023b, p. 652). In this attempt to investigate inter-neurotype intersubjectivity, we have examined characteristics that may fall under the umbrella of empathy, such as attunement. However, we cannot conflate the sharing of emotional resonance with empathy, as we have not thoughtfully reflected upon its definition for this context. Stern (1985) himself suggests that attunement is not equivalent to empathy as it is an automatic awareness of affect and that in his view, empathy requires cognitive processes as well (p. 145). For now, the topic of within and inter-neurotype empathy is unclear.

4.2 Implications for Autism Research and Music Therapy Practice

We found that music positively influences the relationship between attunement by a nonautistic therapist and social interaction from autistic children, importantly, because attunement is a bi-directional process, we see that music enables participatory sense-making in this type of dyad. How neurotypical therapists relate with and form intersubjective space with autistic clients requires further investigation, however. Although previous evidence has demonstrated barriers for nonautistic peers' abilities to understand and relate with the perspectives of autistic counterparts (Sheppard et al., 2016; 2024), research regarding these abilities in groups involving adults and children is lacking. The context of a therapeutic relationship presents additional asymmetry because the client is not expected to act with the same degree of mutuality toward the therapist.

The results of this study indicate that aspects of intersubjective relating between nonautistic therapists and autistic children are present, as consistent attunement facilitated a bi-directional sharing of affective states while. The nature of the treatment fidelity data, however, does not permit closer analysis into how or why these processes may have been enabled or disrupted between a music therapist and autistic child during the interaction as it unfolded. However, we can speculate about the facilitative role of musical interaction in these intersubjective moments on account of its absence in the play-based interaction. Anecdotally, during supervision meetings, some M4A therapists remarked that it can be quite difficult to recognize what the child expects or needs in therapy from one moment to the next. They commented on how music seemed to help them reach a state of togetherness with the children though, with one therapist stating that "everything meaningful was in the music." This sentiment corroborates other first-hand perspectives from therapists about music therapy and its power in ameliorating relational issues with clients (Schwantes & Hughes, 2022). In my view, this further supports the idea that musical interaction can have a facilitative effect on inter-neurotype mutual understanding and possibly provide a space through which the DEP can be circumvented.

Music therapy may also contribute positively to mental health outcomes for people with autism (Gassner et al., 2021). Trevarthen & Delafield-Butt (2013) explain that interventions employing emotionally validating, imitation-based processes that sensorimotor attunement may be particularly impactful for those with autism. They note that collaborative and joyful therapies enhance co-regulation of movements and internal

states and may be beneficial for supporting self-confidence and participation for autistic clients (p.11). Moreover, the quality of the therapeutic relationship has been shown to predict therapeutic outcomes of MT, where "matching the child's affect and level of engagement may promote a positive therapeutic relationship that contributes to intervention success" (Mössler et al., 2019, p. 2806). These positive, inclusive, and validating interactions for autistic children could therefore be incredibly important for their future mental health, especially considering how so many with autism feel "broken" in some way and struggle with social inclusion (Mitchell et al., 2021; Jaswal & Akhtar, 2018).

It has been noted that autism research is split into two streams, one from the perspective of disability and autism studies and another that concentrates on psychological and clinical traits (Marocchini, 2023). For future research on autism and other forms of neurodivergence, we need to strike a balance between medical and neurodiversity perspectives. While we can acknowledge and celebrate the validity and strengths of neurodiversity, autistic individuals may wish for treatments or interventions that help with those differences that hinder positive and joyful daily living. Interventions should therefore focus on improving quality of life and mental health outcomes rather than just symptom reduction (Leadbitter et al., 2021). This is to say that autism research represents a duality of perspectives where it is simultaneously a 'disorder with symptoms requiring treatment' and a 'valid, although disabling, variation in human cognition' where music therapy could embrace the latter perspective while still supporting needs of those on the spectrum (Mössler et al. 2023, pp. 336-337). Another prominent point of contention about psychological research on autism is that autistic people become 'fishbowled,' which is to say they become a population of study that is not included in the scientific endeavor (Murray et al., 2021; De Jaegher, 2023). Furthermore, autistic testimony, regarding e.g., social motivation and empathy, is not taken seriously in psychological investigations of autistic social ability (Jaswal & Akhtar, 2018; Bollen, 2023a, 2023b). At a minimum, qualitative, ethnographic, and phenomenological approaches should also be leveraged in autism research so that we may better evaluate the lived experiences of autistic people and nonautistic people are similar or divergent (Murray et al., 2021).

4.3 Limitations and Future Directions

There are a few caveats to address concerning these findings. Firstly, because inter-rater reliability was considered low, we must contemplate the overall validity of results obtained from treatment fidelity data. Low inter-rater reliability, however, may be explained by the limited range of permitted ratings (0-3) that assessors could select for a given activity. A slight difference in perspective on whether a therapeutic process was implemented 'sometimes' (2) versus 'almost always' (3) would signify rater disagreement using the ICC (2,1) although it may be the case that raters nearly or partially agree but were forced to select between the two ratings (Gwet, 2014, Chapter 1). The imprecision of the rating scale may therefore artificially introduce subjective scoring differences. Given these factors, it may be more appropriate to employ a different technique to assess inter-rater reliability that could lend a level of tolerance to what is considered 'agreement,' such as weighted Cohen's kappa (Li et al., 2023). A further consideration could be made for the selection of the data analysis method. On one hand, the occurrence of multiple hypothesis testing can obfuscate the occurrence of type I errors, while attempting to correct for multiple tests could erroneously result in type II errors. Utilizing a different statistical model to examine the correlational changes could help to account for problems with the error rate from conducting multiple comparisons. On the other hand, an analysis that better captures the interdependence of interactive features, or rather one that examines which processes mediate/moderate others, would be appropriate for understanding how they are related. This investigation also did not account for the order in which the child completed the interventions (see Fig. 2) and whether they were already acquainted with the therapist and the therapy room. This introduces some uncertainty to the interpretation of the results for the correlational change over time analyses that should be considered if these tests are replicated in the future.

Secondly, this study was unable to make inferences about the interactive and affective dynamics of the members of the therapeutic dyad as they unfold within sessions. Because these were assessed on an activity-level basis, there are too few data points to enable an informative analysis. In addition, the ratings correspond to activities regardless of their duration. In many cases, some activities went on for a long period relative to the session length of 45 minutes, leaving significantly less time for the remaining activities. Alternatively, a child may have realized rather quickly that they were not interested in the

chosen activity, so it would last only for a couple of minutes before they moved on to the next. Because of these differences in duration, the respective weight of each rating would also complicate such an investigation. A future endeavor could leverage microanalytical techniques for the coding of treatment fidelity data to capture real-time relational dynamics between the therapist and the child. This should also include additional measures to record the occurrence or frequency of other intersubjective or interactive aspects such as joint attention. A supplemental qualitative data analysis of interviews with music therapists or their notes could also be highly informative regarding their first-hand perspectives of interactive and relational changes between intervention types.

Finally, methodological considerations should be made for the inclusion of autistic people at various stages of research. Consulting with autistic researchers, practitioners, and treatment fidelity raters in experiments involving inter-neurotype interactions would help us better understand therapeutic processes from a neurodivergent perspective and help researchers account for the DEP. There are many areas where autistic and inter-neurotype empirical collaboration might inform further research and our current notions about intersubjectivity more broadly. For example, (how) do autistic and nonautistic treatment fidelity assessors rate sessions differently? How would musical intervention with a therapist who is also autistic affect Attunement, Playful Interaction, or Child Interactions? What about therapeutic outcomes? And what insights would autistic researchers have about methodology and interpretation of results, given their lived experiences? This is a problem in autism studies generally, especially concerning diagnostics and measures of autistic traits, as noted previously (Marocchini, 2023; Milton et al., 2022; Murray et al., 2021). In this case, autistic participation could be very impactful for the further development of MT processes and help us elucidate the dynamics of inter-neurotype and intra-neurotype interaction and mutual understanding in the therapeutic context. A recent example of such an investigation is Mössler et al. (2023), who engaged autistic consultants and parents of autistic children to great effect in evaluating attunement breakdowns and situational context during music therapy. These insights are valuable in improving our understanding of intersubjectivity and interpersonal relating in a manner that considers the diversity of human experience.

4.4 Summary and Conclusions

The aim of this thesis was to investigate the relationships between interaffective and interactional dynamics between nonautistic music therapists and autistic children as a part of the M4A project. We compared music therapy and play therapy to examine how music affected the associations between the therapist's attunement and playful interaction and the child's level of interaction. Although we did not find any affects of music on how the therapist and child interacted with each other, we were able to determine that the therapists' attunement and playful interaction correlated to a significantly higher degree than they did in play therapy, indicating that musical interaction with the child either required or facilitated both forms of intersubjective relating. In exploring how these relationships develop over the course of both interventions, we found that the relationships between therapists' playful interaction with attunement and child interactions decreased significantly, which could indicate that these associations were less critical for the musical interaction. Moreover, the relationship between therapist's attunement and child interactions did not change although the child's level of interaction increased during music therapy. These trends are reflective of distinct intersubjective patterns that transform during MT as the therapist and child proceed through the intervention.

Neurodiversity and double empathy perspectives on autism refute the predominant psychological and clinical definitions of autism as a disorder of social, communicative, and sensory systems, focusing instead on the notion of disability and fostering awareness and understanding between autistic and nonautistic people. The enactive perspective of cognition, compatibly, views the cognizing organism as a holistic, embodied being situated its environment. Together, these approaches acknowledge and validate the sensorimotor and perceptual differences that impact how autistic people engage with the world and the people around them. Above all, working from this perspective allows us to see that nonautistic people are different from autistic people. Nonautistic people perceive their bodies and incoming stimuli with a different degree of sensitivity, and exhibit differences in how they move and behave socially. It is not 'wrong' to be nonautistic. It is not 'wrong' to be autistic. Of course, many characteristics of autism, such as sensory hypersensitivities and verbal language difficulties, necessitate further research into interventions that support, validate, and address these needs. However, the social world primarily operates on a nonautistic frequency that systematically maligns autistic people for their way of

being. Therapeutic interventions that can embrace both aspects are critical. Because music therapy is oriented towards promoting strengths, acknowledgement, and fostering sensory needs, it seems to be especially appropriate for children with autism. In carrying out this project, I have noticed a remarkable correspondence between intersubjectivity and music. The language we use to describe music – rhythm, melody, resonance, timbre – are all applicable for illustrating how we coordinate and relate with each other from the earliest stages of life. Musical interaction may make intersubjective aspects like rhythm more salient and may enable interpersonal synchrony and embodied coordination through the musical object. It is also emotive and expressive, facilitating the sharing of internal states without a need for words. For these reasons, musical interaction could be a useful way to form inter-neurotype relationships and friendships and to create space for mutual understanding.

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Appendices

Appendix A: Table of Tables

Appendix B: Table of Figures

Appendix C: Z-Scores for correlational changes over time

Group	Variable	T1-T2	T2-T3	T1-T3
MT	Attunement & Playful Interaction	2.57	0.82	3.4
	Attunement, Child Interaction	-0.24	1.17	0.96
	Playful Interaction, Child Interaction	0.64	2.01	2.7
PT	Attunement & Playful Interaction	-0.26	0.39	0.13
	Attunement, Child Interaction	1.71	1.06	2.76
	Playful Interaction, Child Interaction	-0.14	-0.05	-0.20

Appendix D: P-Values for variable change over time

Group	Variable	T1-T2	T2-T3	T1-T3
MT	Attunement	0.834	0.222	0.147
	Playful Interaction	0.788	0.341	0.214
	Child Interactions	0.378	0.143	0.018*
PT	Attunement	0.101	0.699	0.238
	Playful Interaction	0.251	0.387	0.787
	Child Interactions	0.643	0.147	0.067

**Significant p-value < .05*