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Parental Responsiveness During Musical and Non-Musical Engagement in Preschoolers with ASD

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Abstract

Background: Parent-child play interactions offer an important avenue for supporting social development in children with autism spectrum disorder (ASD). Musical play is a natural and ubiquitous form of parent-child play. As a familiar, reinforcing, and predictable activity, musical play may support parent-child interactions by scaffolding children's attention to the play activities, while also providing parents with a familiar and accessible context to promote parental responsiveness. However, musical play may also impede interactions due to its sensory and repetitive components.

Method: 12 parent-child dyads of preschoolers with ASD were video-recorded during a ten-minute play session that included musical and non-musical toys. Interactions were coded for parent and child musical engagement, as well as parental responsiveness.

Results: Parent-child dyads varied in their amount of musical engagement during play, which was not related to children's language level. Overall, parents showed similar levels of responsiveness to children's play across musical and non-musical activities, but type of parental responsiveness differed depending on the play context. Parents provided significantly more

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Author Contribution Statement

Olivia Boorom: Conceptualization, Methodology, Writing – Original Draft, Writing – Review & Editing **Valerie Muñoz:** Investigation, Formal analysis, Writing – Original Draft, Writing – Review & Editing **Rongyu Xin:** Methodology, Investigation **Meredith Watson:** Investigation, Writing – Original Draft, Visualization **Miriam Lense:** Conceptualization, Supervision, Writing – Original Draft, Writing – Review & Editing, Funding acquisition

Declaration of Competing Interest

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physical play responses and significantly fewer verbal responses during musical vs. non-musical engagement with their child.

Conclusions: There are substantial individual differences in children with ASD's musical engagement during a parent-child free play. Children's musical engagement impacted type of parental responsiveness, which may relate to the familiarity, accessibility, and sensory nature of musical play/toys. Results suggest that musical play/toys can both support and hinder different types of parental responsiveness with implications for incorporation of musical activities into interventions.

Keywords

ASD; music; parental responsiveness; parent-child interaction

Introduction

Parents are natural social partners to their children during play and shared parent-child engagement is important for supporting developmental skills, such as play and language (Walton & Ingersoll, 2015; Landry, Smith, Swank, & Miller-Loncar, 2000; Bornstein, Tamis-LeMonda, & Haynes, 1999; Tomasello & Farrar, 1986). Parental responsiveness, or the parents' use of "immediate, contingent, and affectively positive reactions to children's acts of communication and play" (Ruble, McDuffie, King, & Lorenz, 2008, p. 158), is a key component of parent-child interactions. Parental responsiveness provides a scaffold for children's skills during their interactions and supports children's development across cognitive, play, and social domains (Bruner, 1975; Ruble et al., 2008; Landry, Smith, & Swank, 2006; Bornstein & Tamis-LeMonda, 1989; Tomasello & Farrar, 1986). For example, in typically developing infants, maternal responsiveness positively predicted children's nonverbal cognition at four years of age (Bornstein & Tamis-LeMonda, 1989). Likewise, maternal responsiveness to children at two years of age is associated with children's language outcomes at three and four years of age (Hudson, Levickis, Down, Nicholls, & Wake, 2015). Parental responsiveness has also been linked to positive developmental outcomes in young children with autism spectrum disorder (ASD) (e.g., Gulsrud et al., 2016; McDuffie & Yoder, 2010).

Child behaviors and the way that parents respond to them differ in quality and quantity in children with ASD. ASD is a common neurodevelopmental disorder characterized by difficulties in social engagement and restricted and repetitive interests, which result in differences in social communication development and play skills in early childhood (American Psychiatric Association, 2013). Children with ASD generally engage with their parent's play behaviors at a lower frequency than typically developing children, particularly in response to their parents' use of social bids (i.e., engaging with facial expressions or vocal cues) (Doussard-Roosevelt, Joe, Bazhenova, & Porges, 2003). Play context, type, and use of toys also impact children with ASD's engagement during play with their parents. Children with ASD demonstrate more engagement during more structured and routine-oriented play such as scenarios involving structured turn-taking or shared music-making versus scenarios involving discussion of objects or pictures (Adamson, Bakeman, Deckner, & Romski, 2009). During parent-child toy play, children with ASD engage more when parents physically

manipulate toys (e.g., by moving or demonstrating the toy) versus when parents verbally comment on toys (Doussard-Roosevelt et al., 2003).

Due to the connection between parental responsiveness and children's development of play and language skills, it is important to provide parents of children with ASD with skills and activities that encourage parental responsiveness and support their engagement with their children (Landry, Smith, Swank, & Miller-Loncar, 2000; Bornstein, Tamis-LeMonda, & Haynes, 1999; Tomasello & Farrar, 1986). Parental responsiveness strategies maintain the child's focus of attention and continue or expand the play idea (versus redirecting the child to a new object/activity) through both physical and verbal acts (Gulsrud et al., 2016; Ingersoll & Schreibman, 2006). Parent physical responsiveness, such as through the use of strategies like mirrored pacing or contingent imitation, are associated with later joint engagement and language development in young children with ASD (Gulsrud et al., 2016; Ingersoll & Schreibman, 2006). Parent verbal responsiveness includes behaviors such as imitating or recasting language back to the child, commenting on what the child is doing, or expanding upon their utterances to increase complexity (Gulsrud et al., 2016; Flippin & Watson, 2015; Landry et al., 2006). Parents' verbal responsiveness during play interactions are associated with child language abilities and growth (Walton & Ingersoll, 2015; Flippin & Watson, 2015; Bottema-Bueutel et al., 2014; Haebig, McDuffie, & Ellis Weismer, 2013). Parent-mediated interventions that employ parent coaching demonstrate that parents of children with ASD can increase their use of responsive behaviors that support their interactions with their child, such as pacing the interaction, contingently imitating their child, and recasting and modeling language for their child (Shire, Gulsrud, & Kasari, 2016; Ingersoll & Wainer, 2013; Green et al., 2010; Ingersoll & Gergans, 2007). In order to best support parental responsiveness during natural play interactions, we must examine how parental responsiveness is impacted by differing play contexts and activities.

Musical activities are a common forum for parent-child engagement (Politimou et al., 2018). Musical activities may afford opportunities for shared engagement between a parent and child because they provide a natural social play context that is predictable, reinforcing, and emotionally modulating (Hernandez-Ruiz, 2019b, Lense & Camarata, 2020). Musical interactions such as child-directed singing increase children's attention to their parent (Nakata & Trehub, 2004) and increase parents' positive social behaviors (e.g., smiling) toward their child (Trehub et al., 2016). The familiarity and predictability of musical experiences may support both children and parents to coordinate their behavior with each other and know what is expected of them in the interaction (Lense & Camarata, 2020). Parents involved in family-centered music-based intervention programs often report that musical play sessions are enjoyable and accessible for both parents and children, and that they can embed musical activities into everyday routines and play, thus providing opportunities for meaningful parent-child interaction and potentially strengthening the parent-child relationship (Thompson, McFerran, & Gold, 2014; Thompson, 2014, 2017; Yang, 2015; Schwartzberg & Silverman, 2017; Thompson, Shanahan, & Gordon, 2019). Additionally, music may capitalize on an area of relative strength in children with ASD since musical abilities are often preserved in individuals with ASD and interest in musical stimuli is often high in this population (Thaut, 1987; Heaton, 2009; Janzen & Thaut, 2018, Quintin, 2019).

Music has long been used by clinicians as a treatment context for children with ASD (Alvin, 1987; Wimpory, Chadwick, & Nash, 1995; Simpson & Keen, 2011). Interventions which utilize musical activities report increased positive affect and increased joint attention behaviors with a social partner such as a therapist or peer as compared to non-music-based interventions (Kim, Wilgram, & Gold, 2008; Srinivasan et al 2015a; and LaGasse, 2015). For example, children with ASD demonstrated significantly more eye contact and longer turn-taking duration with a clinician during improvisational music therapy versus play therapy sessions, suggesting that musical activities may support key early communication skills (Kim, Wilgram, & Gold, 2008). Similarly, children with ASD engaged at a higher rate with a clinician (as indicated by eye contact paired with a communicative behavior) during musical activities versus activities such as cognitive tasks or redirection to a new activity (Wimpory et al., 2007). However, music-based interventions, especially those that utilize musical toys and musical instruments, may also direct attention and engagement toward objects rather than social partners (Srinivasan et al., 2016; Srinivasan et al., 2015b).

Little attention has been given to how musical contexts may impact *parent's* engagement with their children with ASD despite the central role of parents as a child's play partner (Tomasello & Farrar, 1986), the ubiquity of musical activities in early parent-child interactions (Politimou et al., 2018), the interest in music by children with ASD (Janzen & Thaut, 2018; Quintin, 2019), and the increasing focus on teaching parents' skills to support their child's social engagement during play (Ingersoll & Wainer, 2013; Green et al., 2010; Ingersoll & Gergans, 2007). Recent work has explored the feasibility of incorporating music therapy practices with parent-mediated early intervention programs and has proposed frameworks to conceptualize the role of music as a facilitator in parent-coaching programs (Hernandez-Ruiz, 2017; Hernandez-Ruiz, 2019a; Hernandez-Ruiz, 2019b). Since musical activities have the potential to create both shared engagement interactions as well as more repetitive, object focused interactions, measuring how responsive parent behaviors are impacted by the use of musical activities can provide insight into how musical engagement shapes parent-child play. In the current study, we consider children's active engagement with a musical toy for musical or non-musical purposes, singing, rhythmic play on a nonmusical toy (e.g., banging/drumming on buckets), or watching their parent do any of these activities all to be forms of music engagement that provide opportunities for parent responsiveness. While we recognize that children may also be passively engaged in music (e.g., listening to a musical recording), our goal in the current study was to focus on observable behaviors during a parent-child play session that provided opportunities for parental responses.

The purpose of the current study is to characterize parent-child play interactions, including parent responsiveness, across musical and non-musical engagement in young children with ASD through a descriptive cross-sectional design. Our first objective was to measure how frequently children with ASD and their parents demonstrated musical engagement during a parent- child free play session. Based on the previously mentioned literature related to the ubiquity of musical activities in parent-child play and musical interests in many children with ASD, we hypothesized that musical engagement would comprise a substantive portion of the play session but that there would be individual differences in the proportion of play containing periods of musical engagement. Our second objective was to investigate how parent responsiveness may differ during musical and non-musical engagement. We

hypothesized that musical activities may increase overall responsiveness from parents because musical activities are accessible and familiar for both families and children, but also that the way in which parents respond may differ during musical and non-musical engagement. This hypothesis leads to our third objective, to determine whether the mode of parent responsiveness differed (i.e., physical play vs. verbal responsiveness) differed between musical and non-musical engagement. Specifically, we hypothesized that parents will increase their physical play responses during musical engagement due to the clear physical affordances of musical toys (e.g., banging a drum) but that their verbal responses may decrease due to the auditory sensory components. For each of these objectives, we also explored whether child language level was related to different patterns of musical engagement and responsiveness. Understanding if and how parental responsiveness differs with the incorporation of musical activities during play may suggest mechanisms by which musical activities support parent-child engagement and ways in which musical activities can be used in parent-mediated interventions to promote children's communication and play skills.

Methods

Participants

Participants included 12 parent-child dyads who responded to flyers for studies on parent-child musical activities shared at local special needs preschools and an autism research center (families did not have prior experience with music therapy). The 12 children (4 girls) were between 25 and 56 months old ($M = 40.33$ *months*, $SD = 9.23$ *months*) and the caregivers (8 mothers, 3 fathers, and 1 grandmother) were between 26 and 40 years old ($M = 34.27$ *years*, $SD = 4.08$ *years*). Caregiver education level ranged from high school degree to Master's degree with Bachelor's degree as the median level. One caregiver was a grandmother who did not disclose age and education level. (We use the term "parents" to refer to all caregivers throughout the manuscript in order to maintain consistency with terminology in the literature on parent-child interaction and parent responsiveness (e.g., Flippen et al., 2015)). All children had confirmed diagnoses of ASD via clinical best estimate from a comprehensive diagnostic evaluation by a clinician at the academic medical center. The diagnostic evaluation included assessment of autism symptomatology (Autism Diagnostic Observation Schedule, Second Edition (ADOS-2)) (Lord et al., 2012) and developmental functioning (Mullen Scales of Early Learning (MSEL)) (Mullen, 1995). The MSEL (Mullen, 1995) is a standardized assessment of developmental level for children from birth to 68 months of age. In the current study, we averaged children's receptive and expressive language age-equivalence scores from the MSEL as a composite measure of their language level. Participant characteristics, including MSEL scores and ADOS-2 comparison scores[1], are provided in Table 1. Ethical approval for this study was provided by the institutional review board of the university. Written informed consent was obtained by all

[1]ADOS-2 Comparison scores were not available for three participants who received ADOS-2 evaluations prior to the start of the current study (also as part of comprehensive diagnostic evaluations by research-reliable clinicians at the same academic medical center). All three participants met criteria for ASD diagnosis (including ADOS-2 scores that exceeded the cutoff for ASD) prior to entry into the current study.

parents/guardians and children with appropriate language/developmental level provided verbal assent.

Procedures

Parent-child free play procedure—Parent-child dyads were video-recorded during a free play session in an assessment room at the research center. During the play session, the dyads were instructed to play with each other like they play at home for ten minutes using a standard set of toys from a toy bin. The bin contained a farm play set, slinky, stackable buckets, beaded necklaces, snap beads, baby doll with baby bottle, balls, cars, pop'n'pal, foam blocks, rattle, drums, xylophone, maracas, mallets, tambourines, and board books. These items were classified as either traditional musical toys (e.g. maracas, drums, xylophone, tambourines, mallets) or non-musical toys (e.g. a farm play set, pop'n'pal, books, toy cars, baby doll), though note that toys could be played in musical or non-musical ways (see Musical Engagement coding below). Toys were the same for all participants and there was no prior knowledge or assessment of child's preferred toys or interests. Sessions were recorded with two video cameras to capture as much of the session as possible. The videos were then synced and compiled into one video file for each session.

Observational Measures

Videos were coded using a five-second partial interval schema (using ProcoderDV (Tapp, 2003)). Partial-interval sampling segments the observation session into fixed-duration intervals, in which the observer marks the presence of key behaviors that occur at any point during that interval (Yoder, Lloyd, & Symons, 2018). Prior to coding for variables of interest, intervals were determined to be codable or uncodable. Intervals were considered uncodable if child or parent behavior was out of view, interruptions occurred (e.g., phone rings), or child exhibited significant distress or disruptive behavior that would require behavior modification/comforting. Only codable intervals were then used for the subsequent coding schemas, which were conducted in two phases by two separate pairs of researchers. In the first phase, children's attentional leads and corresponding parent responses (physical toy play and verbal responses; see below) were coded. In the second phase, intervals involving musical engagement by child or parent, including use of musical toys and/or active music making, were identified.

Child Attentional Leads and Parent Responsiveness.—Child attentional leads and parent responsiveness coding were adapted from established schemas (Bottema-Beutel et al., 2014; Flippin et al., 2015; Sandbank et al., 2017) and were coded in two reviews through the video. In the first review children's attentional leads were coded. Attentional leads could include: (1) look leads (visual attention to a toy/person/activity for at least one second); (2) touch leads (touching, moving, or using an object for at least one second); and/or (3) verbal leads (clear verbal communication initiated by children). If parents redirected a child to a new toy/activity, children only received credit for a lead once they maintained focus on that toy/activity for two subsequent 5-second intervals. In the second review through the video, presence of three types of parental responsiveness were coded for all intervals in which the child exhibited a lead: (1) Verbal responses (parent verbalizations that reference and have a semantic relationship to the child's attentional focus); (2) physical play responses (physical

play acts that reference or support the child's touch or verbal attentional leads (e.g., parent imitates child's action with a toy or gives the child a toy that the child verbally requested)); (3) routinized responses (e.g., singing lyrics to a song; reading text of a book). Parent response types could occur alone or in combination but must occur in the same interval as the child's attentional lead, therefore, no greater than 5 seconds after the onset of the child's lead. For analyses of parental responsiveness, we examined the proportion of leads to which parents provided a response overall, and by response type. Descriptions of coded behaviors for child leads and parent responsiveness are provided in Table 2a.

Musical Engagement.—Musical engagement was coded in phase two and was coded separately for each parent and child. The coding schema considered two different types of musical engagement referencing both how the toy was used (i.e., whether or not the toy was used to make music) and the type of toy used (i.e., traditionally musical or non-musical toys). This distinction allowed us to examine if musical toys afforded different opportunities for types of play or parental responses separately from actual music making since musical toys can be used in non-musical ways (e.g., naming colors of xylophone bars; stacking tambourines) and non-musical toys can be used for music making (e.g., drumming on upside down buckets with hands). For each 5-second interval, each person could receive a code of: (a) Music Making: participant actively producing rhythmic sounds with or without using traditionally musical toys (e.g., singing a song, playing the xylophone, drumming on upside down buckets); or (b) Musical Toy: participant engaged with a musical toy for non-musical purposes (e.g., stacking drums in a tower). Examples of coded behaviors for the musical engagement schema are summarized in Table 2b.

The two musical engagement codes were only coded when a parent or child was observed to be making music or visually attending to/physically engaging with musical toys/singing. Therefore, children's musical engagement was only coded for intervals in which the child had an attentional lead (on average, 93% of intervals had a child's attentional lead).[2] All codable intervals were coded for parent musical engagement in order to capture parents' overall propensity for music engagement during parent-child play sessions (distinct from their responsiveness to children's musical and non-musical leads).

Reliability

Coding was completed by two separate teams of two coders for the first phase (child attentional leads and parent responsiveness; 25% of videos co-coded for reliability) and second phase (music engagement; 50% of videos co-coded for reliability) of coding. Percent agreement was 96.0% for children's play leads, 96.4% for parent responsiveness, 94.6% for child music engagement, and 95.5% for parent music engagement. Intra-class correlation values were 0.80 for children's play leads, 0.95 for parent responsiveness, 0.98 for child music engagement, and 0.90 for parent music engagement.

[2]While individuals can attend to music without an observable response (e.g., passive listening), our schema requires an observable behavior that can be coded. This is consistent with our research objective into parental responsiveness to children's musical versus non-musical engagement, which requires children to exhibit an observable behavior to which parents have the opportunity to respond.

Analysis Plan

To investigate our first objective, we utilized descriptive statistics to examine individual differences in child and parent musical engagement in the context of overall child attentional leads and parental responsiveness. Assumptions for parametric testing (e.g., normality of distributions) were met; therefore, parametric tests were used for subsequent statistical comparisons. Significance of statistical tests were evaluated at $\alpha < 0.05$. To explore our second objective, we examined if parental responsiveness differed based on whether or not children exhibited musical engagement leads using paired t-tests. To address our third objective, we used paired t-tests to investigate whether type of parent responsiveness (physical or verbal responsiveness) differed for child musical and non-musical engagement. We conducted exploratory correlational analyses to investigate if children's language level was related to either their attentional leads, musical engagement or their parent's level of responsiveness. For all codes, proportions were used in order to control for individual differences in frequencies of children's leads. All analyses were conducted using RStudio (RStudio Team, 2015).

Results

Child and Parent Musical Engagement

Child Music Engagement.—Individual participant data for child leads and parental responsiveness with or without musical engagement are provided in Table 3 and 4, respectively. Children demonstrated attentional leads during 93.5% (*SD = 5%*) of codable intervals on average (*range 82.8%-98.1%*), suggesting that children were highly engaged with the free play materials. Children displayed substantial individual variability in the frequency of musical engagement during the play session. Overall, children's leads included some form of musical engagement 53.8% of the time (*SD = 20.7%*, *range = 22.8%-81.6%*). Children's musical engagement most frequently took the form of Music Making (*M = 35.7%*, *SD = 14.2%*, *range = 10.9%-55.3%*). Children's use of Musical Toys (for non-musical purposes) (*M = 18.2%*, *SD = 10.5%*, *range = 3.5%-34.8%*) was also observed. Proportions of children's leads (overall, non-musical, or music-related) were not associated with their language composite age equivalences (r's ≤ 0.15, p's ≥ 0.64), suggesting that language level did not drive the variability in children's overall engagement or whether they engaged in musical or non-musical activities.

Parent Music Engagement—Parents engaged with music significantly less on average than their children (*M = 38.6%*, *SD = 13.8%*, *range = 20.0%-59.2%*; $t(11) = -4.21$, $p = 0.0014$, $d = 1.22$). Parents' musical engagement involved Music Making in 31.1% of intervals (*SD = 10.6%*, *range = 13.3% - 45.0%*), while parents used Musical Toys (for non-musical purposes) in 7.5% of intervals (*SD = 5.6%*, *range = 1.0% - 20.8%*).

Parental Responsiveness and Relationship with Child's Musical Engagement

We next examined parental responsiveness to children's leads. Parents responded to their children's attentional leads 63.0% of the time on average (*SD = 12.1%*). Parents primarily utilized physical play (*M = 39.5%*, *SD = 10.6%*) and verbal responses during play (*M =*

37.8%, *SD* = *14.1%*). Routinized utterance responses (*M* = *6.5%*, *SD* = *6.4%*) were less frequent.

We next examined if child music engagement during attentional leads impacted responsive parenting behaviors. Because all categories of musical engagement provided children and parents with an affordance for engaging in music making (even if the child or parent did not actively make music in that given interval), we collapsed across music engagement codes for an overall category of musical engagement. We repeated analyses restricting music engagement to only intervals with active music making and results were consistent.

There was no significant difference between overall parental responsiveness to musical (*M* = *65.0%*, *SD* = *16.9%*) versus nonmusical (*M* = *58.2%*, *SD* = *17.0%*) leads; $t(11) = 1.51$, $p = 0.16$, $d = 0.44$ (Figure 1). However, parents made a significantly greater proportion of physical responses to children's musical engagement leads (*M* = *46.1%*, *SD* = *16.0%*) than nonmusical engagement leads (*M* = *32.0%*, *SD* = *15.6%*), $t(11) = 2.65$, $p = 0.02$, $d = 0.76$. Parents made significantly fewer verbal responses to children's musical engagement leads (*M* = *30.2%*, *SD* = *13.5%*) than nonmusical engagement leads (*M* = *46.2%*, *SD* = *16.4%*), $t(11) = -4.47$, $p < 0.001$, $d = 1.29$. We did not compare parental routinized responses to musical vs. non-musical leads due to the low frequency of this response type (8 of 12 parents used fewer than ten routinized responses during the play session).

Pearson correlations were computed to examine the relationships among parental responsiveness and child language level. There were negative correlations between child language level and parent physical play responsiveness to all leads ($r = -0.69$, $p = 0.01$) and to non-musical leads ($r = -0.67$, $p = 0.02$); a similar pattern was evident for parent physical play responses to children's music leads though this relationship did not reach conventional statistical significance levels ($r = -0.55$, $p = 0.066$). There were no significant relationships between parent verbal responses and child language.

Discussion and Implications

The current study characterized the use of musical engagement (music making and/or musical toys) during parent-child dyadic play interactions and examined the relationships between musical engagement, parent responsiveness, and child language level. We found substantial individual differences in amount of musical engagement by children and parents. Child's musical engagement was not related to the child's language abilities suggesting that engagement with musical activities occurs in preschool-aged children with ASD across a range of developmental levels. Child and parent engagement in musical play and/or with musical toys may reflect a combination of child interest/motivation, parental responsiveness to their child's engagement, and parent direction of the play session toward or away from musical toys/activities.

Parental responsiveness to children with ASD during play is critical to support children's joint engagement and language development (McDuffie & Yoder, 2010; Ruble et al., 2008; Landry, Smith, & Swank, 2006; Bornstein & Tamis-LeMonda, 1989; Tomasello & Farrar, 1986). Overall, parents responded to ~63% of their children's attentional leads by verbally

commenting and/or physically engaging in the child's activities. While overall proportion of parental responsiveness was similar for child's musical and non-musical engagement leads, parents were significantly more likely to use physical play responses and less likely to provide verbal responses to their child's musical leads than to their child's nonmusical leads. Caregivers employed responsive parenting strategies during the music activities but musical contexts naturally modulated parent-child interactions.

Parents' reduced verbal responses during musical play may be due to the sounds and noise created by the musical toys, which may limit parents' opportunities to provide meaningful verbal responses. In a prior study with children with ASD, Down syndrome, and neurotypical children, children attended to parents' speech less during play scenarios designed to elicit social interaction, such as a music toy sharing activity, versus scenarios designed to elicit commenting, such as a picture sharing activity (Adamson et al., 2009). The current study suggests that this could be due in part to reduced frequency of parent speech during musical activities and not only that children were less responsive to speech during the interaction versus commenting condition.

In contrast, parent physical responsiveness increased during children's musical engagement leads versus non-musical leads. Parental responsiveness types were all coded as independent categories; therefore, the use of verbal responses during non-musical play did not preclude parents' simultaneous use of physical responses to these non-musical play leads. The familiarity and affordances of musical toys/activities may increase parents' tendency to physically support or join in to their child's play (e.g. playing together on a xylophone or taking turns drumming). Prior studies indicate that children with ASD are more responsive when parents engage their child with physical object play rather than by verbally commenting on an object (Doussard-Roosevelt et al., 2003). Increased social engagement by children with ASD during music-based activities (e.g., Kim et al., 2008; Wimpory et al., 2007) may relate in part to naturally-occurring increased physical responsiveness of the child's adult partner during these sessions. Alternatively, parents may have individual differences in their general tendency to respond to their child's leads and may have increased their physical responses during musical engagement as a consequence of decreasing their verbal responses.

Parental responsiveness via physical play acts was negatively correlated with their child's language skills. While these findings are in contrast to previous work that demonstrates a positive relationship between physical responsiveness and child language skills (e.g., Gulsrud et al., 2016; Ingersoll & Schreibman, 2006), this is likely due to the broader heterogeneity in language skills of our sample. Examples of physical responses during play ranged from supportive play (e.g., giving/showing toys, hand-over-hand helping) to interactive play (e.g., turn-taking, joint-cooperative play, and imitating). While we did not see relationships between child language level and parent verbal responsiveness, this may be due to the broader language level and age range of our sample compared to prior studies (e.g., Bottema-Beutel et al., 2014; Flippin et al., 2015). Parent verbal responsiveness was also lower in our study compared to some prior samples (e.g., Flippin et al., 2015), potentially because musical toys may naturally promote more physical responsiveness and fewer verbal interactions.

Clinical Implications

Foundational features of early intervention approaches for children with ASD such as naturalistic developmental behavioral interventions (NDBIs) include the importance of following the child's lead and creating supported engagement opportunities to scaffold pivotal skills. Therefore, musical activity contexts must be considered carefully when being incorporated as part of intervention programs, either when delivered directly to the child by a clinician or when teaching strategies to parents through parent-coaching and parent education. These findings are consistent with recent work arguing that, particularly for children who find musical activities to be highly preferred and motivating, music may provide opportunities to scaffold reciprocal interactions between children and a play partner because it allows play partners to capitalize on that child's attention (Hernandez-Ruiz, 2019a; Hernandez-Ruiz, 2019b; Lense & Camarata, 2020). Our finding that parents naturally increased their use of physical responses during child's musical engagement leads suggests that musical activities may provide a context conducive to teaching parents NDBI strategies that incorporate physical responsiveness. Consistent with this, a parent participating in a music-based parent coaching NDBI demonstrated modest increases in their non-verbal responsiveness to their child across the music-based sessions in a recent single subject study (Hernandez-Ruiz, 2019a). NDBIs that incorporate imitation training may be well suited for incorporation of musical activities since physical responsiveness (via contingent imitation, modeling, and prompting) is a key element for scaffolding imitation skills during play (Ingersoll & Dvortcsak, 2010; Ingersoll & Schreibman, 2006). Such physical responsiveness in musical contexts can occur with musical toys (e.g., banging on a drum or shaking maracas) or also by using song activities to model and imitate actions with non-musical toys (e.g., singing the Wheels on the Bus song when supporting a child in functional play (rolling a toy bus) or pretend play (acting out activities with toy figures riding on a toy bus)). While parental physical responsiveness in the current study required use of an object, this activity could also be extended to scaffold imitation of gestures, such as using a familiar song and taking turns adding new physical movements. Musical engagement can also be used to scaffold higher level play skills during interaction, which has been explored in clinician-led interventions (Wimpory et al., 2007; Kim, Wilgram, & Gold, 2008). For example, parallel play during periods of musical engagement may be a bridge to move toward a reciprocal interaction, such as call-and-response play, which can then be scaffolded to interactive play as has been described in interventions that integrate music therapy and NDBI approaches (e.g., Hernandez-Ruiz, 2017; Hernandez-Ruiz, 2019b; Lense & Camarata, 2020).

At the same time, there are caveats around the use of musical activities given that some musical activities may discourage flexible and responsive verbal input by play partners. Parent verbal responsiveness is associated with children's subsequent language skills (e.g., Bottema-Beutel et al., 2014; Perryman et al., 2013; Siller & Sigman, 2002). If music making with musical toys makes up a majority of the child's play or preferred activities, the sound may limit (perceived) opportunities for parents to respond verbally to their child. Clinicians, early intervention providers, and music therapists may need to teach parents strategies for structuring musical play interactions in ways that encourage parental verbal responsiveness. Musical engagement involving turn-taking or call-and-response games that have built-in

pauses, as well as music engagement without musical toys (e.g. singing along while playing a simple game) may limit object and sensory-focused behavior and provide parents with opportunities to respond verbally, including through varying song lyrics to match a child's play activities.

Limitations and Future Directions

While the effect of musical play on differential forms of parental responsiveness is robust, limitations of the current study suggest directions for future investigation. One limitation is the small sample size and the heterogeneity in age and developmental and language level. Additionally, all participants in the study responded to research recruitment materials indicating musical play opportunities, such that the sample may have included families particularly interested in music. However, there was still significant variability in participants' engagement with music during the free play, and children's musical engagement did not correlate with their language level. Musical engagement during the free play may have been impacted by the number of musical/non-musical toys available, the child's level of interest in musical toys and play, and also by the parent's level of interest in musical toys and play (or parents' beliefs about how interested their child would be in musical play), since some parents were more directive in their play style. The potential impact of parent direction of child attention is mitigated by requiring children to attend to a toy/activity for repeated intervals following their parent introducing it in order for the child to have "adopted" the activity as their own lead that could be coded. Nevertheless, in order to control for this variability, future studies could examine parent-child play interactions in three separate conditions: One play session with only musical play/toys, one with no musical toys or activities provided, and one with directions to interact in musical activities/games without stereotypical musical toys.

All children in our sample had ASD. Future studies could also examine these patterns of music engagement and parent responsiveness in parent-child dyads with neurotypical children or children with other disabilities to examine if music engagement impacts behaviors similarly regardless of children's diagnosis or communication needs. In a prior study, young children with ASD or Down syndrome were less likely to be unengaged during play scenarios designed to elicit parent-child social interaction, including a scenario focused on sharing musical toys, versus scenarios designed to elicit commenting (e.g., sharing pictures), while typically developing children showed similar amounts of unengaged behavior regardless of condition (Adamson et al., 2009). Children in all three groups attended more to their parent's speech (i.e., by following verbal directions or verbally responding to parent's speech) during the comment-eliciting versus interaction-eliciting scenario but this effect was less robust in the ASD vs. neurotypical or Down syndrome groups. However, it is unclear to what extent parents differed in their use of speech versus children's attention to the parents' speech across these conditions.

An additional limitation of this study is that our parental responsiveness coding schema did not qualify the "success" of the parent response. Future studies could examine *how* parents were supporting their child's play (e.g., parents use of contingent imitation versus modeling) and whether those play interactions were sustained or reciprocated by the child. For

example, prior studies report increased nonverbal communication such as eye contact and turn taking in children with ASD in response to a clinician engaging the child with improvisational music therapy versus play therapy (Kim et al., 2008), but we do not yet know if the same patterns are observed in parent-child interactions (either at baseline or change over time for families participating in parent-mediated therapies). Since children with ASD have particular weaknesses in nonverbal social communication (American Psychiatric Association, 2013; Wetherby, Prizant, & Hutchinson, 1998), understanding how musical engagement impacts verbal and nonverbal intentional communication between parent and child is an important next step toward structuring musical activities for clinical intervention. Measuring child reactions to parent responses would allow for investigation of whether children with ASD differentially respond to parents' nonverbal communication acts (such as during parents' physical play responses) in comparison to parents' verbal communicative acts (e.g., parents' verbal responses). Due to the constraints of the free play task in the current study (e.g., camera angles), it was not feasible to measure child reactions to parent responses, such as via eye contact.

Conclusions

The current study demonstrates broad individual differences in young children with ASD's musical engagement during parent-child play and that parents employ different strategies to be responsive to their child during musical and non-musical engagement. Parents' increased use of physical responses to their children during musical engagement suggests that music may provide an avenue for supporting parent-child play interactions. However, the decrease in parents' verbal responsiveness to their children during musical engagement warrants consideration for how musical toys and activities are incorporated into interventions and suggests parents may need additional support from clinicians in structuring musical play activities. Due to the important role of parental responsiveness in supporting the developing social skills of young children with ASD (McDuffie & Yoder, 2010; Ruble et al., 2008; Landry, Smith, & Swank, 2006; Bornstein & Tamis-LeMonda, 1989; Tomasello & Farrar, 1986), the nature of musical parent-child play interactions and their potential to be harnessed in naturalistic early intervention contexts warrants further investigation with focus given to how musical activities impact both child and parent behavior.

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Highlights

- Children with ASD vary in their engagement during play
- Parents are responsive to their children's musical and nonmusical play
- During musical play parents use more physical play and fewer verbal responses
- Results have implications for use of music in parent mediated therapy

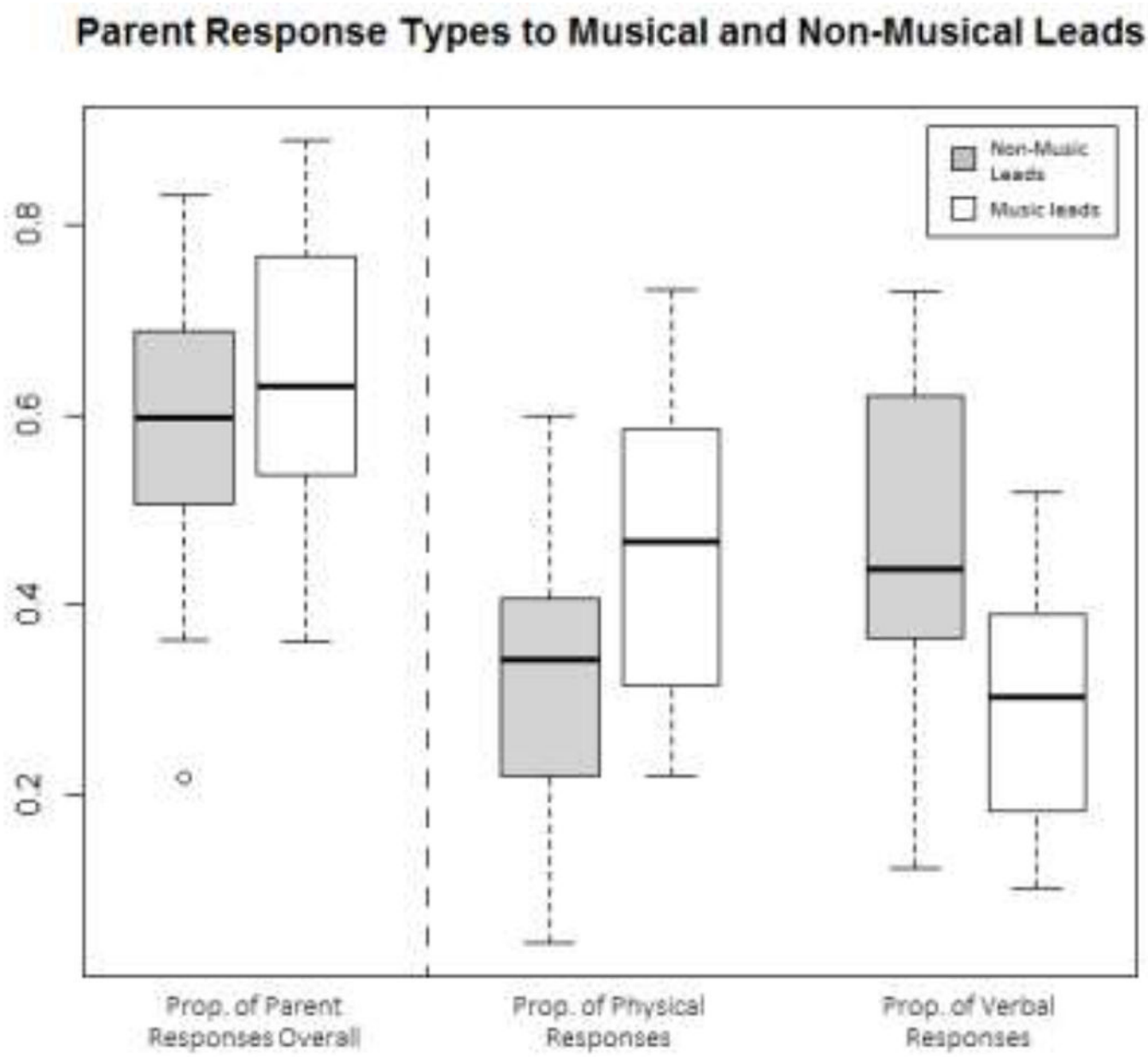

Figure 1.
Parent responsiveness overall and by type to children's musical and nonmusical leads

Table 1.

Participant demographics

Participant	Sex	Age (months)	ADOS-2 CS	MSEL VR T score	MSEL VR AE	MSEL Language Composite T score	MSEL Language Composite AE
1	M	47	NA	55	48	39	36
2	M	40	9	21	26	20	17
3	M	40	8	60	48	50.5	41.5
4	F	34	NA	20	19	24.5	15
5	F	29	8	20	12	21.5	12.5
6	M	36	10	20	17	20	7
7	F	44	5	51	41	20.5	23
8	M	35	2	33	24	34	23
9	M	56	10	20	29	20	18
10	F	45	NA	20	18	20	10.5
11	M	25	6	42	23	35	19
12	M	53	7	20	27	20	22
Mean		40.33		27.67	31.83	27.08	20.38
SD		±9.23		±11.96	±15.84	±10.15	±9.97

Note: VR AE= MSEL Visual Reception scale (i.e., non-verbal problem solving) in age equivalents (AE; months), Language Composite AE = average of MSEL Expressive Language and Receptive Language scales in age equivalents (months). MSEL T scores are standardized with a mean of 50 and SD of 10. ADOS-2 CS = ADOS-2 Comparison Score. Comparison Scores range from 1-10 with 10 being highest level of autism-related symptoms. All participants had confirmed diagnoses of autism based on comprehensive diagnostic evaluations, one component of which was the ADOS-2.

Table 2.

Child attentional lead and parent responsiveness coded behaviors (2a) and musical engagement coded behaviors (2b)

a)

	Variable	**Definition**
Child Attentional Leads	Look lead	Child gaze (≥ 1 second) toward a specific referent
	Touch lead	Active touching (moving object with hand or moving hand on object; ≥1 second) of a referent
	Verbal lead	Child verbalization toward a referent
Parent Responsiveness	Verbal response	Parent verbal utterance that is about the child's focus of attention and has a specific semantic relationship to the child's focus of attention
	Physical response	Parent physically engages with child's referent (e.g., imitating child's action with same or similar referent, aiding the child's action, demonstrating a new action on the referent, and/or demonstrating a new action on a different object related to the child's referent)
	Routinized response	Parent utterance that has a routinized form such as reading, singing, counting, etc.

b)

Variable	**Definition**	**Examples**
Music making	Active rhythmic sound making using either musical instruments/toys, non-musical toys, or voice	Shaking maracas Singing song Playing xylophone with mallets Banging on buckets as drums
Musical toy	Active engagement with a musical instrument/toy for non-music making purposes	Stacking drums Naming colors on xylophone Putting maracas in a bucket

Table 3.

Individual data for proportion of intervals with child leads, proportion of child leads involving musical engagement, and proportion of child leads without musical engagement.

Participant	Proportion of Child Leads to Codable Intervals	Proportion of Child Leads: Musical	Proportion of Child Leads: No Music
1	0.96	0.31	.69
2	0.98	0.23	.77
3	0.88	0.79	.21
4	0.97	0.58	.42
5	0.96	0.66	.33
6	0.83	0.28	.72
7	0.96	0.71	.29
8	0.95	0.48	.52
9	0.94	0.66	.34
10	0.94	0.63	.37
11	0.90	0.82	.18
12	0.95	0.32	.68
Mean	0.93	0.53	0.46
SD	±0.05	±0.21	±0.21

Table 4.

Individual data for proportion of child leads with parent responses (PR) overall and by type during periods with and without musical engagement

Participant	Overall PR		Verbal PR		Physical PR	
	Music	No music	Music	No music	Music	No music
1	0.36	0.54	0.19	0.43	0.22	0.24
2	0.52	0.59	0.26	0.36	0.30	0.37
3	0.63	0.36	0.48	0.36	0.25	0.05
4	0.51	0.47	0.24	0.37	0.33	0.20
5	0.63	0.61	0.14	0.45	0.47	0.42
6	0.88	0.68	0.35	0.41	0.73	0.35
7	0.60	0.22	0.10	0.13	0.52	0.09
8	0.89	0.83	0.52	0.73	0.61	0.34
9	0.55	0.58	0.18	0.45	0.46	0.39
10	0.70	0.78	0.39	0.63	0.43	0.60
11	0.73	0.63	0.38	0.63	0.56	0.47
12	0.81	0.69	0.39	0.62	0.64	0.31
Mean	0.65	0.58	0.30	0.46	0.46	0.32
SD	±0.16	±0.17	±0.13	±0.16	±0.16	±0.16