THE IMPACT OF ELECTRONIC TOYS ON THE QUALITY AND QUANTITY OF LINGUISTIC INPUT PROVIDED BY PARENTS OF CHILDREN WITH AUTISM SPECTRUM DISORDER

By

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ABSTRACT

THE IMPACT OF ELECTRONIC TOYS ON THE QUALITY AND QUANTITY OF LINGUISTIC INPUT PROVIDED BY PARENTS OF CHILDREN WITH AUTISM SPECTRUM DISORDER

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Although electronic toys have become increasingly prevalent over the past decade, recent studies show that these toys may decrease the linguistic quality of parent utterances in typically developing (TD) children. However, there is little evidence to support the impact these toys may have on parent-child interactions for children with autism spectrum disorder (ASD), who may also exhibit difficulty processing language in noise and may show delays in language development. To address this current gap in knowledge, the current study investigated parent-child interactions during two, 10-minute, play sessions with 14 children with ASD (2-4 years old) and their parents. One session utilized traditional toys, and the other utilized electronic toys (counterbalanced across participants). Overall, play with electronic toys resulted in lower linguistic quality of parental language input, including a significant difference in unique word roots per minute, pause time, number of words per minute, and auditory overlap. Parent grammatical complexity and number of total words did not significantly differ between toy types. This shows that traditional toys may be more beneficial to child language development and suggests that electronic toy play may elicit lower quality language input from parents of children with ASD.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

Over the past decade, electronic toys have become increasingly prevalent compared to traditional (i.e., non-technologically advanced) toys. In addition to becoming more available to families, electronic toys are often marketed as being more beneficial for children's development, compared to traditional toys (Healey et al., 2019; Zosh et al., 2015). However, current research has shown that electronic toys may decrease the linguistic quality of parent utterances in typically developing (TD) children, (Miller, Lossia, Suarez-Rivera, & Gros-Louis, 2017; Sosa, 2016; Wooldridge & Shapka, 2012; Zosh et al., 2015). There are few studies that investigate the impact electronic toys may have on parent-child interactions for children with autism spectrum disorder (ASD), who may also exhibit delays in language development. Although clinical observation and anecdotal evidence suggest that children with ASD are particularly drawn to electronic toys that sing, flash lights, and have talking voices, we need to understand if the type of toy used during play may affect the language that children with ASD hear from their parents or caregivers.

Research shows that both environmental factors and child-based factors contribute to variability in language development for TD children and children with ASD, informing the importance of parent input during play (J. Bang & Nadig, 2015; Fusaroli, Weed, Fein, & Naigles, 2019; Nadig & Bang, 2017; Venker et al., 2015). Specifically, the quality and quantity of adult language input are consistently correlated with language skills in TD children and children with ASD. Because children with ASD often exhibit early language delays (Ellis Weismer et al., 2010), the quality and quantity of language input they receive may be even more important compared to TD children. It is crucial to consider how and if the quality and quantity of parental input varies with the type of toy used during play for children with ASD.

In addition, little research has considered another way in which electronic toys may affect the quality of linguistic input: by creating more background noise and auditory competition. This is concerning because background speech and noise in general can have a negative impact on young children's ability to recognize and process speech and language, causing distraction and attention shifts (Erickson & Newman, 2017). In the current study, we considered the quantity and linguistic quality of parent language input as well as the extent to which background noise and speech overlapped with (and thus competed with) parent utterances during traditional versus electronic toy play.

Autism Spectrum Disorder

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), ASD is a neurodevelopmental disorder characterized by persistent deficits in social communication and a profile of restricted interests and repetitive behaviors (American Psychiatric Association, 2013). Individuals with ASD may present with varying severity in signs and symptoms. Severity is based on social communication impairments and the impact of restricted, repetitive behaviors may have on an individual's functioning in everyday life (American Psychiatric Association, 2013). In 2002, estimates of ASD diagnosis were found between six to seven per 1,000 children (Fombonne, 2009; Rice et al., 2004). However, according to the most recent period covered (2016), the Center for Disease Control and Prevention (CDC) now estimates that one in 54 children are diagnosed with ASD across all ethnic and socioeconomic groups (Maenner et al., 2020). This shows an increase in the diagnosis of ASD in the last 20 years. In addition, boys are four times more likely to be identified with ASD compared to girls (Maenner et al., 2020), although recent literature has begun to examine the hypothesis of camouflage in girls, through which females with ASD may use compensatory behaviors to mask their social challenges (Dean et al., 2017).

Although structural language skills (i.e. vocabulary, grammar) are not part of the DSM-5 diagnostic criteria for ASD, the vast majority of young children with ASD experience delays in language development (Ellis Weismer et al., 2010; Lord et al., 2004). Studies suggest that toddlers with ASD are varied in their individual language development, but often exhibit early delays in language across receptive (Fusaroli et al., 2019; Gleitman, 1984; Naigles & Bavin, 2015) and expressive abilities (Eaves & Ho, n.d.; Kjelgaard & Tager-Flusberg, 2001; Mitchell et al., 2006; Paul et al., 2008).

Overview of Language Acquisition

Language acquisition has been shown to be a function of child-based factors and environmental factors in TD children and children with ASD (Fusaroli et al., 2019; Gleitman, 1984; Naigles & Bavin, 2015). Child-based factors may include biological components, as well as verbal and nonverbal intelligence (Fusaroli et al., 2019). Additionally, children learn language through the linguistic input in their environment from parents or caregiver's speech and language in everyday context (Bohannon & Bonvillian, 2005; Haebig, McDuffie, & Weismer, 2013; Swanson et al., 2019). Children's early learning environment, including the quality of parent-child interactions, learning activities, and availability of learning materials have also been shown to predict later academic and language skills (Rodriguez & Tamis-LeMonda, 2011; Tamis-LeMonda et al., 2019).

Although not all aspects of language can fit neatly into two categories, previous studies show robust evidence that the amount (i.e. quantity) and quality of language that children are exposed to influences their language development. Input quality can include variables like grammatical complexity of parent speech, including the mean length of utterance (MLU) and different number of words produced, among others (J. Bang & Nadig, 2015).

Fusaroli et al. (2019) stated that the focus of research for TD children and children with ASD regarding environmental and child-based factors has largely been linked to the population being studied. Past research has primarily investigated environmental factors for TD populations (Gathercole & Hoff, 2007; Madigan et al., 2019; Rowe, 2012), while research for children with ASD has emphasized the variability in the severity of diagnosis and language outcomes (Anderson et al., 2007; J. Bang & Nadig, 2015). However, in the last decade, robust evidence has shown the importance of the quality of parental input for language acquisition in children with ASD (J. Bang & Nadig, 2015; Fusaroli et al., 2019; Nadig & Bang, 2017; Venker et al., 2015) further informing the need to consider parental input during play.

Adult Language Input for Typically Developing Children

There is robust evidence that the amount (i.e. quantity) and quality of adult language input is associated with concurrent and later language abilities in children with typical development (Gathercole & Hoff, 2007; Rowe, 2012). Early lexical development, in particular, has been shown to be directly related to the linguistic input that children are exposed to (Hoff & Naigles, 2002; Newport et al., 1977; Pan et al., 2005; Rowe, 2012). Children who receive greater amounts of input, as well as more diverse and responsive input, demonstrate stronger lexical development (Hart & Risley, 1995; Rowe, 2012).

Evidence shows that it is important to consider both the quantity and quality of adult language input for TD children. After collecting language samples from 42 families over 2 ½ years, Hart and Risley (1995) found that TD children who were exposed to the greatest number and diversity of words had more advanced vocabularies compared to their same age peers at age 3, which predicted advanced language and literacy skills later in life in this longitudinal study. Additionally, Hoff and Naigles (2002) found that the quantity, lexical richness, and syntactic complexity of parent input was associated with stronger language skills in typically developing 2-year-olds.

Further supporting the importance of the quantity and quality of language for TD children, Rowe (2012) conducted a longitudinal investigation of parent-child interactions, concluding that diverse, sophisticated vocabulary and decontextualized language contributed to later vocabulary ability in TD children at age 18 months and 30 months. At child age 18 months, the amount of parent input was most related to later vocabulary acquisition. They conclude that in the early stages of vocabulary acquisition, the more input a child receives provides more exposure to language. However, at child age 30 months, Rowe (2012) found that parent input that was rich in vocabulary diversity and sophistication was most related to later vocabulary acquisition. They conclude that at 30 months, children may have a vocabulary base that can build on more sophisticated or quality of parental language input (Rowe, 2012).

Adult Language Input for Children with ASD

Although there is significant heterogeneity in language development among individuals with ASD, children with ASD tend to achieve language milestones later than their TD peers (Kjelgaard & Tager-Flusberg, 2001). Previous studies in the ASD literature have emphasized child-based factors as predictors of language development (e.g. cognitive ability), but environmental factors (e.g. parental input) have also been shown to play an important role in early language development (Fusaroli et al., 2019; Swanson et al., 2019; Venker et al., 2015). As in TD children, the quantity and quality of linguistic input from a parent or caregiver is linked with language outcomes in children with ASD. Because language learning mechanisms can be delayed in children with ASD, the quality and quantity of parental input may be especially important to consider.

The quality or complexity of parent language is an important factor in language development for children with ASD. Fusaroli et al. (2019) discuss the importance of parental language input specifically for preschool aged children with ASD in a longitudinal corpus of 32 preschoolers with ASD and 35 TD peers. Comparing development among children with ASD and linguistically matched TD peers, Fusaroli et al. (2019) found that although children’s initial language levels were stronger predictors of their successive linguistic performance (child-based factors), parental input, specifically the syntactic complexity of parental speech (MLU), was a significant predictor of the children’s productions at the subsequent visit. The authors suggest that this emphasizes the importance of parental syntactic complexity specifically for children with ASD (Fusaroli et al., 2019). In addition, Bang, Adiao, Marchman and Feldman (2019) reviewed 4 studies considering children with ASD, and found that parent input with greater sentence complexity, increased quality of engagement, and responsiveness to child-directed speech was associated with stronger language skills for children with ASD. The complexity of sentences used by caregivers was positively associated with children's language outcomes later in life (J. Y. Bang et al., 2019).

MLU is an important factor in the literature further contributing to the importance of language input quality of parental language. Sandbank and Yoder (2016) documented a positive predictive relation between parent MLU and later language skills of children with ASD through a correlational meta-analysis. Results suggest that the length of parent input (i.e. MLU) is strongly associated with language outcomes later in life (Sandbank & Yoder, 2016). This positive predictive relation between MLU and later language skills for children with ASD is also supported by Bang and Nadig (2015), who found that parent's MLU positively predicted children with ASD's spoken vocabulary 6 months later.

Additionally, Choi et al., (2020) investigated parent-infant dyads who were at a high-risk (n = 53) or low-risk (n = 33) for ASD in their first 2 years of life on the basis of whether their older sibling had an ASD diagnosis. They found that parents produced similar word tokens, word types, and word proportions of contingent verbal responses for both parents of high-risk and low-risk infants. However, the parents with high-risk infants used shorter mean length of utterances. The authors found that parent MLU was significantly positively correlated with children's language skills 6 months later, suggesting that parents who used longer utterances had children with stronger language skills (Choi et al., 2020).

Another aspect of linguistic quality that may affect child language development is telegraphic (i.e., ungrammatical) adult speech. An example of telegraphic speech would be, “Cat drink milk” rather than the grammatically correct utterance, “The cat drinks milk”. Venker et al. (2015) found that during naturalistic, play-based interaction, higher rates of telegraphic speech (more obligatory determiners from object noun phrases were omitted) were significantly associated with lower lexical diversity for children’s spoken language. They report that this preliminary evidence shows that the syntactic complexity of parental speech may impact language development in children with ASD (Venker et al., 2015).

Although it is evident that aspects of linguistic quality are crucial to consider, the amount of language input that children are exposed to has also been shown to be an important factor in language development for children with ASD. In a longitudinal study of 96 infants, Swanson et al. (2019) concluded that a home environment rich in language (e.g. hearing more words from adults and participating in more conversational turns) at 9 and 15 months was associated with better language skills for children with ASD later in life.

Electronic and Traditional Toy Play

Play has been established as an important and powerful way for children to learn in their environment (Caruso, 1988). Play-based interactions can be influenced by the type of object and toy used, introducing different opportunities for acquiring and learning language (Wooldridge & Shapka, 2012; Yogman et al., 2018). Although a variety of different toys may help facilitate child development, including language, offering opportunities to engage with caregivers or peers in play-based interaction is an essential part of play with toys.

Although the concept of play may not have fundamentally changed over the past century, the toys themselves have drastically evolved. An increasing number of toys including electronic features (e.g., lights, singing, talking) can be found in toy aisles alongside more traditional (i.e. non-technologically advanced) toys. Electronic toys are often marketed to parents as toys that stimulate and encourage important developmental skills, enhancing their perceived educational quality (Yogman et al., 2018). Levin and Rosenquest (2001) found that families listed educational value at or near the top of important qualities listed when purchasing toys for their children. Healey (2019) also suggests that many caregivers believe expensive electronic toys are essential for their child's healthy development.

Current research has begun to consider the impact that technologically advanced toys may have on children's development. Some researchers emphasize the positive impact of technologically enhanced toys, specifically for TD children. Bergen (2004, 2007) indicated that toys with technological features should follow design guidelines to incorporate the toy play quality of traditional toys, while adding value through technology enhancements. Bergen, Hutchinson, Nolan and Weber (2010) conducted a study with a toy manufacturer to investigate communicative and play interactions with a technology-enhanced toy for 26 infant-parent dyads. Across six 25-minute sessions of play with a technology-enhanced toy, parents' MLU remained similar, but word and morpheme complexity increased as the children's language facility increased. They concluded that augmented toys may promote similar benefits to traditional toy play by encouraging adult-child interaction and learning (Bergen et al., 2010). However, they did not directly compare traditional toys to electronic toys.

Additionally, Sung (2018) found that mothers exhibited more overall interactive behaviors with their children (affection, responsiveness, encouragement, and teaching) when playing with a battery operated, electronic puppy doll, compared to a traditional, non-technologically advanced puppy doll. However, the association between conception and pretend play behavior was elevated (mothers: 2%; children, 4%) during play with the traditional puppy doll. The authors inferred that these results show positive potential of toys with digital technology to expand children's creative play skills, cognitive development, and communicative skills for TD children (Sung, 2018).

However, researchers have also considered potential negative impacts of technologically advanced toys for children. Levin and Rosenquest (2001) raise questions to the validity and limitations of the advertised educational advantages, concluding that electronic toys can be harmful in the healthy play and development of young children (but see Marsh, 2002). Specifically regarding language development, electronic toy play has been shown to decrease the quality and quantity of parental language input compared to traditional toy play for TD children (Sosa, 2016). Results from studies specifically investigating electronic and traditional toy play will be discussed in the following section.

Parent Language Input during Electronic and Traditional Toy Play

There were no published studies identified in the literature search that compared parent language input during electronic and traditional toy play in kids with ASD. However, four studies were identified that considered aspects of parent language input during play with electronic and traditional toys for TD children (J. L. Miller et al., 2017a; Sosa, 2016; Wooldridge & Shapka, 2012; Zosh et al., 2015). A summary of these studies can be found in Table 1.

Table 1: Previous Research Findings

Citation	Objective/research questions	Participants	Methods	Variables	Results
Miller, Lossia, Suarez-Rivera et al (2017)	Understand how play with different toy types affects infant communicative and cognitive behavior, as well as parents' responses	50 infant-parent dyads TD	Dyads participated in a 20 minute play session, in one of two categories (feedback - electronic; or traditional - no electronic) Condition 1: two 10 minute periods for each set Condition 2: both sets combined for 20 minute duration	• Infant vocalizations • Infant gestures • Infant attentional shifts • Parent contingent feedback on infants vocalizations and gestures • Parents sensitivity	Toy type influenced the quality and quantity of parent-child interactions Infants produced fewer vocalizations & parents had fewer contingent responses to infant communicative behavior when playing with electronic toys
Sosa (2016)	Type of toy used during play & association with parent-infant communicative interaction	26 parent-infant dyads TD	3 toy sets In child's home Two 15 minute toy play sessions over 3 days (each set played with twice)	• Numbers of adult words • Child vocalization • Conversational turns • Parent verbal responses to child utterance • Parent responses per minute	Electronic toy play yielded a decrease in the quantity and quality of language input from parents compared to play with traditional toys or books.
Wooldridge and Shapka (2010)	The goal of this study was to examine the differences in parent-child interactions during play with traditional toys or electronically-enhanced toys.	25 participants (dyads) 16-24 months old TD	One electronic set of toys, and one traditional set (book, shape sorters, barn and animals) for two sequential, 10-15 minute play session in their home.	Four domains of parent-child interactions: • Affection • Responsiveness • Encouragement • Teaching	Researchers found a statistically significant difference between toy conditions and dependent variables. PICCOLO scores were higher in the traditional toy play condition.
Zosh et al. (2015)	1. How does quantity and quality of language children hear compare between toy types? 2. Does parents' use of spatial language differ when playing with electronic versus	24 parent child dyads (mean age of 24 months) TD	1 shape sorter (either electronic or traditional for 7 min play session)	• Number of total words (parent + toy) • Number of parent words • Number of unique words • Amount of spatial language • Focus, content of speech	<u>Quantity:</u> The rate of total words (parent + toy) was higher in electronic toy play (M=91.20 words). No effect of condition on overall rate of parent words alone. Less overall parental talk with electronic toy. <u>Quality:</u> Higher proportion of unique words in traditional toy play -

These research studies consider the quantity and/or quality of parental language during play with toys. To investigate parent-infant communication during play, Sosa (2016) examined 26 parent-infant dyads in their homes. Infants (aged 10-16 months) were not reported as having a known disorder affecting language development and could be considered TD children (although two children were identified with moderate developmental delay). Three toy sets were utilized; a set of three traditional toys, a set of books with no electronic features, and an electronic toy set with battery-operated toys that produced lights, words, phrases, and/or songs. The dyads engaged in two 15-minute play sessions per day for three days, utilizing each toy set independently twice throughout the study.

Sosa (2016) considered the quantity of language by measuring the number of overall adult words, number of content-specific words, and number of child vocalizations. Qualitative measures were considered through conversational turns and the number of parent responses per minute. In this study, electronic toys yielded fewer overall adult words, fewer conversational turns, fewer parent responses, and fewer productions of content-specific words compared to the traditional toy set and set of books. Results showed that the least consistent and smallest difference existed between traditional toys and books. From these results, the researchers suggest that electronic toys are associated with decreased quantity and quality of language input from parents compared to traditional toys or books (Sosa, 2016).

Further investigating parent language input for TD children, Miller, Lossia, Suarez-Rivera and Gros-Louis (2017) conducted an experiment and detailed behavioral analysis of parent and infant behavior during play sessions with different toy types. Fifty infant-parent dyads participated in a 20 minute toy play session to Condition 1 or Condition 2. Condition 1 was divided into 10 minutes of play with traditional toys (i.e. no automatic or electronic response to manipulation) and 10 minutes of subsequent play with feedback toys (i.e. electronic sound or automatic movement in response to manipulation). Condition 2 was a combination of feedback and traditional toys for the 20-minute play period.

Miller et al. (2017) examined the effect of Toy Set (traditional vs. feedback) on three infant behaviors, including directed vocalizations, directed gestures, and joint attention, as well as two parent behaviors, contingent feedback to vocalizations and gestures, and sensitivity. From these categories, descriptive statistics identified that the type of toy influenced both the quality and quantity of parent-child interactions. Overall, parents had more responses to infants' vocalizations and gestures during traditional toy play, compared to play with electronic toys. Similarly, infants had an increased level of directed vocalizations and gestures during traditional toy play. However, shorter durations of sustained attention were found during traditional toy play (J. L. Miller et al., 2017b).

Further informing the literature, Wooldridge and Shapka (2010) compared the quality of 25 parent-toddler interactions during play, using toy sets with and without electronic features. They considered the quality of parent-toddler interactions to cover four domains of parent-child interactions, including affection, responsiveness, encouragement, and teaching. The dyads participated in two sequential 10-15 minute play sessions, counterbalanced across participants—one with electronic toys and one with non-electronic toys. Results from a checklist of observable parent behaviors indicated a statistically significant difference between the two toy conditions on the dependent variables combined. Specifically, scores were higher for the play sessions that utilized traditional toy play compared to electronic toy play, across all four domains. However, the affection and encouragement domain did have higher scores in the electronic play session for 20% and 12% of participants (respectively), suggesting that the electronic toys may offer benefits of holding children's attention. The results indicate that electronic toys could potentially negatively affect the quality of parent-toddler interactions.

Zosh, Verdine, Filipowicz, Golinkoff, Hirsh-Pasek and Newcombe (2015) also compared the quantity and quality of the language children hear from their caregivers during play with a traditional shape sorter and an electronic shape sorter. Specifically, they considered how language from parents compares between toy types, and if spatial language differed during play with electronic versus traditional shape toys. A between-subject design was used, with 24 parent-child dyads randomly assigned to one of two shape sorting toys for 7-minute play sessions. Zosh et al. (2015) considered both parent speech and toy speech as variables, which was a unique aspect of this study. The researchers considered overall language quantity to be the rate of total (parent + toy) words as well as the rate of parent words produced alone. The researchers considered quality of speech to be the rate of unique parent words, and unique total words (parent + toy).

Results showed that the rate (i.e., words per minute) of total words (parent +toy) the child heard was higher in electronic toy play, while the rate of parent words produced alone did not differ significantly (electronic M=55.82 per minute; traditional M

= 70.53 per minute), although traditional toy play elicited slightly more language from parents. However, regarding quality of parent language, children in the traditional toy condition heard a higher proportion of unique words per minute, considering both total words and parent words alone. In addition, a decrease in spatial language was observed during play with the electronic toy shape sorter. Therefore, Zosh et al. (2015) suggested that traditional toys may introduce greater variation and amount of spatial talk from parents.

Overall, all four studies found lower overall quality and/or quantity of parental language input for TD children when playing with electronic toys, when compared to traditional toys. This evidence informs our research for children with ASD moving forward.

Auditory Overlap

In addition to affecting structural characteristics of parent speech (e.g., vocabulary, grammar), electronic toys may also affect the quality of adult language input by increasing the presence of background noise, introducing auditory overlap. As previously stated, this is concerning because background speech and/or noise can have a negative impact on children’s ability to recognize and process speech and language, particularly for children with ASD (Erickson & Newman, 2017). Though previous research has primarily focused on TD children, children diagnosed with ASD may have even more difficulty discriminating and comprehending speech sounds when background noise is present (Dunlop et al., 2016; O’Neill & Jones, 1997). One source of increased background noise for children during play with parents or caregivers involves electronic toys that produce a variety of noises, including speech, songs, animal and/or vehicle noises.

Alcántara, Weisblatt, Moore, & Bolton (2004), conducted a study on performance of both ASD and TD individuals with speech discrimination in noise. Their findings suggest that difficulty perceiving speech-in-noise for individuals with ASD may be due to difficulty integrating information from changes in competing speech. Individuals with ASD may have difficulty taking advantage of temporal dips, or brief pauses in speech, that TD individuals often utilize during noise to catch 'glimpses' of the target speech and language (Alcántara et al., 2004).

According to Dunlop, Enticott, & Rajan (2016), individuals with ASD are often hypersensitive to auditory stimulation, and may present with a variety of auditory processing behaviors that are abnormal, compared to TD peers. Attentional deficits may also affect the ability of individuals with ASD to discriminate speech sounds from background noise. Individuals with ASD also perform below their TD peers with tasks that require complex auditory processing, including prosody, speech intonation, and visual-auditory integration (Dunlop et al., 2016). They are also less likely to rely on contextual cues that TD individuals identify to help them distinguish speech in noise (Qian & Lipkin, 2011).

The Current Study

There is evidence that electronic toys affect the quantity and quality of parent language input, although studies have focused on typically developing children. No published studies, to our knowledge, have investigated the impact of electronic toys on the input provided to children with ASD, which is concerning given that the quality and quantity of adult language input is consistently associated with child language outcomes in this population. It is crucial to investigate whether and how toy type influences the quality and quantity of parent language input for children with ASD. To our knowledge no studies of children with or without ASD have investigated the rates of background noise introduced by electronic toys.

Here, we investigate three specific empirical questions. First, how does the quality (i.e., structural characteristics) and quantity (i.e., amount) of parent language differ during play with traditional and electronic toys with children with autism? Variables of structural characteristics to investigate quality of parent language include parent lexical diversity (rate of different word roots), grammatical complexity (MLU), and pause time. Variables of quantity will also be investigated, including rate of total complete and intelligible (C&I) utterances and rate of total words per minute. Regarding quality, we will consider the structural characteristics of parent language, including lexical diversity (number of different words per minute), grammatical complexity (MLU), and pause time. Although previous literature has not specifically considered pause time, this could add additional insight into the quality of parental speech by considering their responsiveness during each play condition. We hypothesized that both the quality and quantity of parent input would be significantly lower with electronic than with traditional toys.

Second, we asked: How do these findings change if we also consider the language produced by the toys? We hypothesized that children will hear language of a higher quality when playing with traditional toys compared to electronic toys, although they may be exposed to more overall language (i.e. higher rate of total words per minute) when considering both parent and toy speech.

However, electronic toys may also introduce overlapping sounds and/or language, which could be considered background noise. Our third research question asked: To what extent does speech and/or background noise overlap with (and thus compete with) parent utterances during traditional versus electronic toy play? We expected that electronic toys may introduce language and sounds that may distract or take away from the overall parent language input. We predicted that the amount of background noise would be significantly higher during electronic than traditional toy play. If these hypotheses are supported, this will suggest that child/caregiver play with electronic toys may reduce the overall quality of parent language input that children with ASD are exposed to compared to play with traditional toys.

Methods

This thesis project used existing data from Dr. Venker's lab. The research study was prospectively approved by MSU Institutional Review Board (IRB). Parents provided written informed consent. My role included overseeing student transcription of parent-child play videos, processing data, and deriving relevant variables, analyzing the data, interpreting the results, and writing the thesis document.

Participants

Participants were 14 children with ASD between 2 and 5 years of age and their parents. The average age of the child at the initial visit was 43.5 months (range of 26-71 months, 11 males). Most children showed severe delays in language and cognitive skills. All child participants were previously diagnosed with ASD. Additionally, 10 children were reported to have additional diagnoses. All families indicated English as their primary language with no reported exposure to an additional language (100%). Child ethnicity was composed of 93% Caucasian and 7% Black or African American. Parents included number of years of education for both parent one and two, if applicable. Paternal and maternal education and additional demographic information are presented in Table 2.

Table 2: Descriptive Data on Study Participants

Variable	Category Responses	Response count	Response percentage
Child age at visit 1	Mean (SD)	44 mo (12.4)	NA
Child gender	Male	11	85%
	Female	3	15%
Race/Ethnicity	Non-Hispanic White	13	93%
	Black or African America	1	7%
Parent Education	8 to 12 years	11	39%
	13 to 17 years	13	46%
	18+ years	4	14%

Procedure

During an in-person visit that spanned two days (no more than two weeks apart), dyads participated in a broad study focused on word learning and visual attention. For this project, we specifically considered the toy play sessions. The participants completed the Autism Diagnostic Observation Schedule, second edition (ADOS-2), Preschool-Language Scale, 5th edition (PLS-5), and the Visual Reception subscale from the Mullen Scales of Early Learning (MSEL). The ADOS-2 is a semi-structured, standardized assessment with play-based activities designed to obtain objective information regarding severity and characteristics of ASD, including restricted interests, repetitive behaviors, and communication skills (Lord et al., 2012). The PLS-5 is a developmental language assessment designed to assess receptive and expressive language abilities children aged 0 – 7;11 (Zimmerman et al., 2011). The MSEL is an assessment of cognitive development, and is organized into 5 subscales to assess learning abilities and patterns in various developmental domains in children 2 to 5 ½ years of age. The Visual Reception Scale of the MSEL was given to assess performance in processing visual patterns, including visual organization, memory, sequencing, and spatial awareness (Mullen, 1995).

Table 3: Child Characteristics: Standardized Assessments

Assessment	Mean	SD	Range
Child age at first visit (months)	43.5	12.39	45
ADOS Severity Score	8.71	1.28	4
PLS-5 AC Standard Score	63.71	15.78	48
PLS-5 AC Percentile	6.79	12.11	44
PLS-5 AC Age Equivalent (months)	23.57	14.42	47
PLS-5 EC Standard Score	70.43	12.55	43
PLS-5 EC Percentile	6.85	9.16	31
PLS-5 EC Age Equivalent (months)	24.43	12.61	50
MSEL VR Age Equivalent	29.00	14.86	52

ADOS: Autism Diagnostic Observation Scale, PLS-5 AC and EC: Preschool Language Scale, 4th Edition, Auditory Comprehension and Expressive Communication, MSEL VF: Mullen Scales of Early Learning, Visual Reception.

Parent-Child Play Sessions

The parent-child dyads participated in two 10-minute play sessions, one on each day. Two play sets were utilized; one consisted of traditional toys (no electronic features) while the other consisted of electronic toys. Both toy sets included a barn with animals, a shape sorter, spiky sensory balls, three vehicles, a puzzle, and a pull toy dog (see Figure 1). Toys in the electronic toy set made sounds and/or flashed lights, while the toys in the traditional toy set did not. Dyads received the traditional play set on one day, and the electronic play set on the other (counterbalanced across participants). In this way, each parent-child dyad serves as their own control. Parents were told to interact and play with their child as they normally would at home.

Figure 1: Traditional and Electronic Toy Sets

Transcription of Language Samples

Play sessions were videotaped and all parental and toy utterances were transcribed by trained research assistants. The use of Systematic Analysis of Language Transcripts (SALT) software guided transcription to assess the quality and quantity of parent spoken language. This software standardizes the process of eliciting, transcribing, and analyzing language sample (Miller & Inglesias, 2006). Each research assistant was required to complete seven online training sessions with video presentations, discussion with team members, and review of written instructional manuals ensure fidelity of transcription of language samples.

The transcription process involved a first draft by a primary transcriber, feedback by a secondary transcriber, and further discussion and consensus transcription by the team for a final transcript. Each play session was transcribed and coded for the variables of interest and compared in traditional toy play vs. electronic toy play. Unless otherwise noted, variables were represented as a mean number per minute to account for small differences in total sample length. Relevant variables were chosen based on previous findings that support that the quality of varied linguistic input for children with ASD positively effects child language development (J. Bang & Nadig, 2015; Hart & Risley, 1995; Rowe, 2012; Venker et al., 2015). Similar to Zosh, et al. (2015), considering both parent language alone and parent + toy language input allowed our team to compare the variety and amount of language heard during play with electronic toys. Unless otherwise noted, variables were represented as a mean number per minute to account for small differences in total sample length. Play samples averaged 10.39 minutes (SD = .73).

To address the first research question, the parent's language was investigated for variables of language quality and quantity. These variables included number of words per minute, number of utterances produced per minute, lexical diversity (i.e., number of different word roots per minute), mean length of utterances (MLU), and percentage of pause time during a given sample. Only complete and intelligible utterances were transcribed by SALT as communication units (C-units), defined as an independent clause and its modifiers (Miller & Inglesias, 2006a). If 4 seconds between vocalizations or another utterance elapsed, this was considered to be a pause. See Table 4 for a summary of parent language variables.

Table 4: Parent Language Input Variables

Parent Language Quantity	Parent Language Quality
Number of complete and intelligible utterances produced per minute	Lexical diversity: Number of different word roots per minute
Number of words per minute	Grammatical complexity: Mean length of utterance (MLU) in morphemes = total # morphemes/total # utterances
	Percentage of pause time

In addition, to consider the total language input children were exposed to during play with traditional and electronic toys, our second research question examined how these variables differed when we considered the language from the toys in addition to parent language. *Total* language variables incorporated both toy words/utterances + parent words/utterances (i.e., all language heard; see Table 5).

Table 5: *Total* language Input: Parent + Toy Speech

Total Language Quantity (Parent + Toy)	Total Language Quality (Parent + Toy)
Total number of complete and intelligible utterances produced per minute	Lexical diversity: Number of different word roots per minute
Total number of words per minute	Grammatical complexity: Mean length of utterance (MLU) in morphemes = total # morphemes/total # utterances
	Percentage of pause time

Finally, the extent of auditory speech/noise that overlapped (and thus compete with) parent utterances during traditional versus electronic toy play was investigated (see Table 3). Parent utterances were coded as having auditory overlap if they overlapped with child vocalizations, child speech, or electronic toy noises (both speech and non-speech). During traditional toy play child speech and/or vocalizations was the only source of auditory overlap with parent language input. During electronic toy play, parent utterances coded with overlap may have been caused by the child's speech and/or vocalizations, as well as toy speech, sounds, and/or music.

Inter-Transcriber Agreement

We evaluated inter-transcriber agreement by comparing transcripts prepared independently by two separate pairs of transcribers, each of which was comprised of a primary and secondary transcriber. Four language samples (29%) were randomly selected for each play condition. Variables relevant to the study were examined and compared in each transcription. Inter-transcriber agreement averaged 86% across the relevant variables. Table 6 presents a detailed analysis of average agreement for each relevant variable.

Table 6: Inter-Rater Agreement

Variable	Play Condition	Average Agreement
Number of Utterances by Length	Traditional toys	86.29%
	Electronic toys	90.48%
Number of total utterances (C&I)	Traditional toys	90.35%
	Electronic toys	94.88%
Number of different word roots	Traditional toys	96.24%
	Electronic toys	97.15%
Parent utterances with overlapping speech	Traditional toys	86.02%
	Electronic toys	81.29%
Pauses between utterances	Traditional toys	71.02%
	Electronic toys	66.80%
AVERAGE INTER-TRANSCRIBER AGREEMENT		**86.05%**

Analysis

Given the limited sample size, data were analyzed using Wilcoxon Signed-Rank Tests, the non-parametric version of a paired t-test. The toy set served as the within-participants factor, allowing each dyad to serve as its own control.

Results

Parent Language Input

The first research question was: How does the quality (i.e. structural characteristics) and quantity (i.e. amount) of parent language differ during play with traditional and electronic toys with children with autism? Previously identified variables and results are described in Table 7. On average, parents produced 16.03 different word roots in the traditional condition and 14.60 different word roots in the electronic condition. A Wilcoxon Signed Rank Test revealed that this difference was significant (p = .036). There was no statistically significant difference in parent MLU across the two conditions (traditional M = 3.44; electronic M = 3.46; p = .976). The average percentage of total pause time during the traditional condition (16%) was significantly lower than pause time in the electronic condition (24%; *p* = .005).

Figure 2: Quantity Measures of Parent Language Production

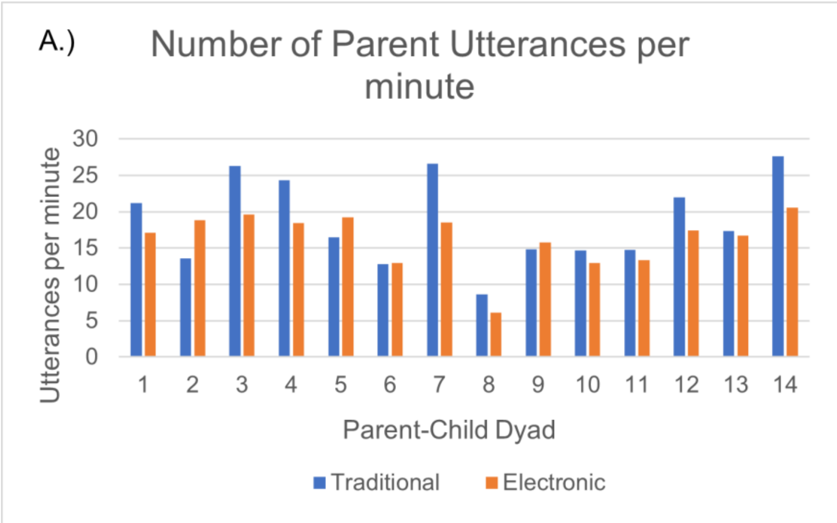
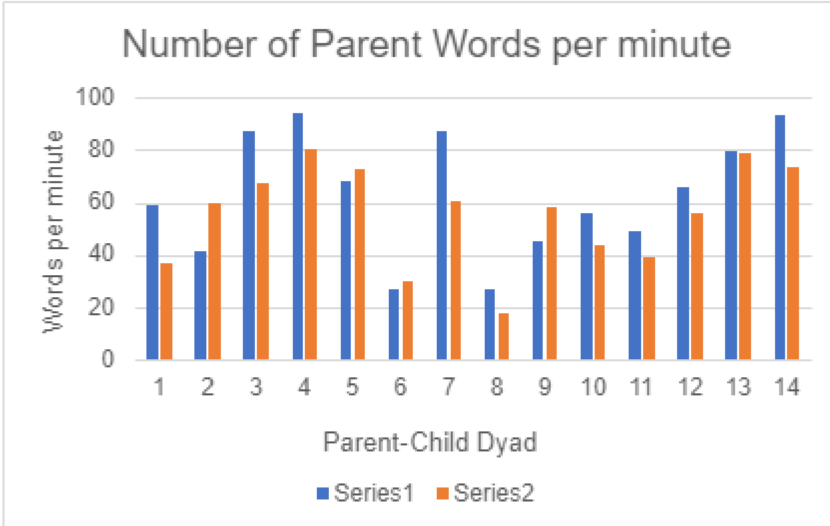


Figure 2: (cont'd)



On average, parents produced significantly more utterances during the traditional toy condition (M =18.65) compared to the electronic toy condition (M = 16.25). A Wilcoxon Signed Rank Test revealed that this difference was significant (p = .048). Although the traditional toy condition elicited a higher rate of total parent words (M =62.85) compared to the electronic condition (55.3) this did not reach statistical significance (p=.064).

Figure 3: Quality Measures of Parent Language Production

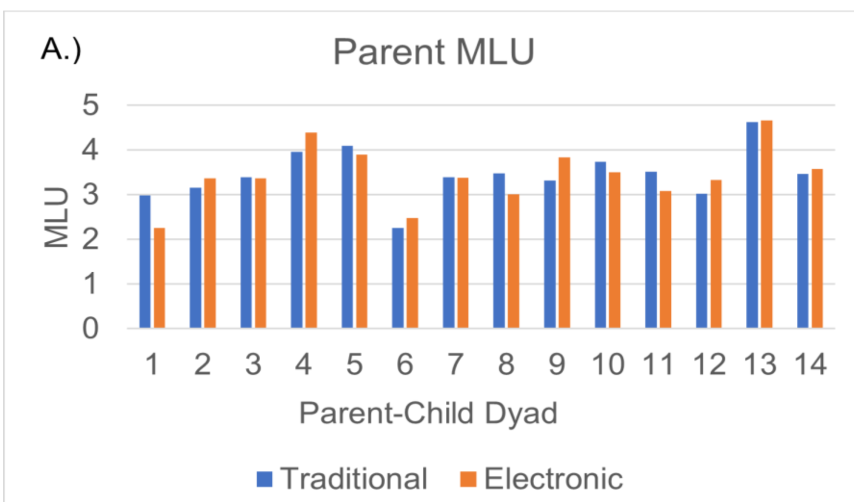
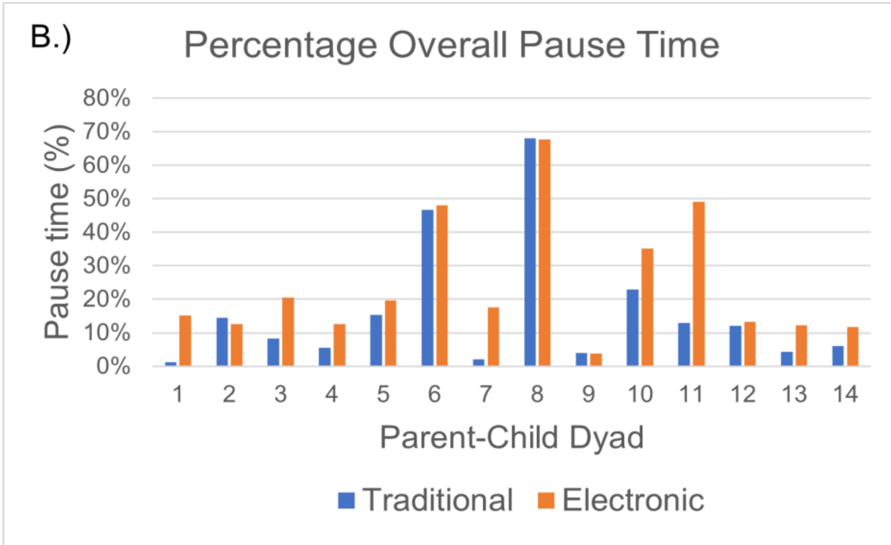


Figure 3: (cont'd)



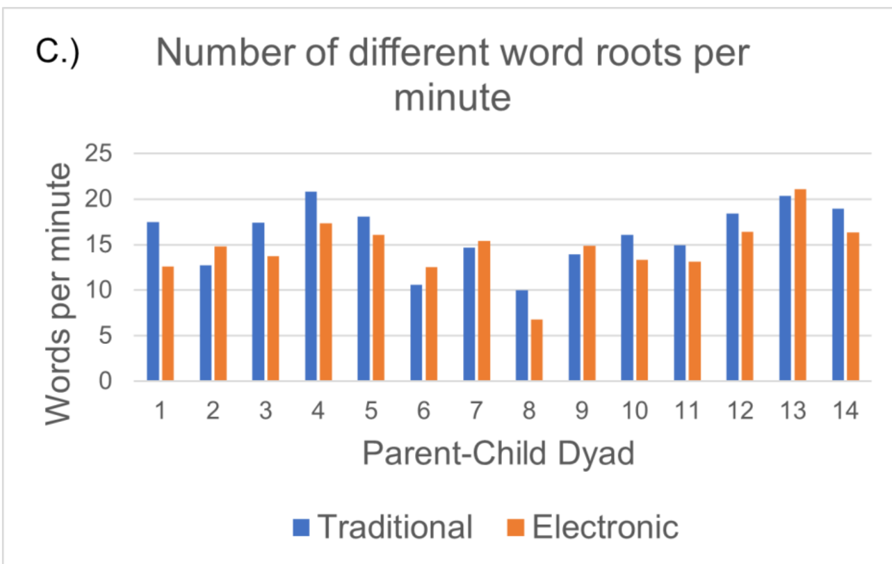


Table 7: Descriptive Statistics for Parent Language Input

Variable	Traditional		Electronic		Comparison
	Mean (SD)	*Median*	*Mean (SD)*	*Median*	*p*
Number of different word roots per minute	16.03 (3.37)	16.75	14.60 (3.20)	14.84	**.036**
MLU in morphemes	3.46 (.56)	3.43	3.37 (.65)	3.45	.976
Percentage of pause time (%)	16 (18.97)	10.17	24.25 (18.52)	16.42	**.005**
Number of utterances per minute	18.65 (5.98)	16.94	16.25 (3.83)	17.28	**.048**
Number of words per minute	62.85 (23.21)	62.43	55.33 (19.19)	59.17	.064

Total (Parent + Toy) Language Input

The second research question was: How do these findings (considering the total language input children were exposed to) change if we also consider the language produced by the toys? The rate of different word roots, on average, was significantly greater for parent + toy language during the electronic toy condition (M = 20.34) compared to parent language during the traditional toy condition (M = 16.03; p = .004). On average, the overall rate of parent + toy words during the electronic toy condition (M = 79.97) was significantly higher compared to the overall rate of parent words during the traditional toy condition (M =62.85; p = .016). MLU in morphemes was also significantly higher when considering toy speech + parent language input (p = .002). The rate of total utterances (C&I) did not significantly differ between the electronic toy condition (M = 20.47) and the traditional toy condition (M = 18.65; p = .271). See Table 8 for a summary. More pause time was observed during play with traditional toys (M = 16%)

compared to electronic toys (M = 10.83%) when parent and toy input is considered (p=.298).

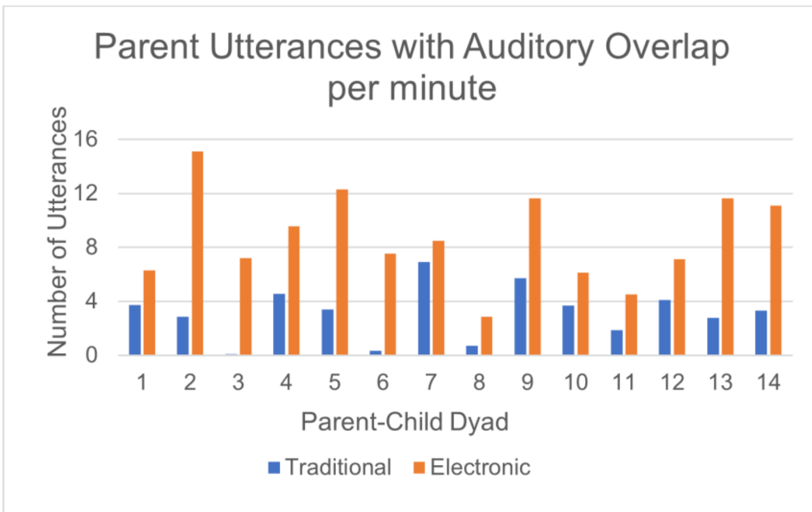
Table 8: Descriptive Statistics for Total Language Input (Parent + Toy)

Variable	Traditional		Electronic		Comparison
	Mean (SD)	*Median*	*Mean (SD)*	*Median*	*p*
Number of different word roots per minute	16.03 (3.37)	16.75	20.34 (3.74)	19.92	**.004**
MLU in morphemes	3.46 (.56)	3.43	4.02 (.65)	4.10	**.002**
Percentage of pause time (%)	16 (18.98)	10.17	10.83 (11.14)	6.59	.298
Number of utterances per minute	18.65 (5.98)	16.94	20.47 (3.74)	19.90	.271
Number of words per minute	62.85 (23.21)	62.43	79.97 (21.79)	79.06	**.016**

Auditory Overlap

Finally, the third research question asked: To what extent does speech and/or background noise overlap with (and thus compete with) parent utterances during traditional versus electronic toy play? On average, 3.15 (median = 3.36, SD = 1.95) parent utterances (CI) per minute were found to have auditory overlap during the traditional toy condition, while 8.67 (median = 8.03, SD = 3.37) parent utterances (CI) per minute exhibited auditory overlap during the electronic toy condition (See table 7). A Wilcoxon Signed Rank Test revealed that there were significantly more parent utterances (CI) with auditory overlap during the electronic condition (which included overlap from child vocalizations and toy words/utterances) than during the traditional condition (p = .001). Given that parent utterances averaged 18.65 per minute, approximately 17% of parent's complete and intelligible utterances were overlapped by child vocalizations. During play with electronic toys, on average, parents produced significantly fewer complete and intelligible utterances per minute (M=16.25) which results in 53% of parent speech competing with auditory overlap.

Figure 4: Rate of Parent Utterances with Auditory Overlap



Discussion

Quality and Quantity of Parental Language Input

Results from this study revealed that the type of toy influenced key aspects of parent language input for children with ASD. During play samples with both electronic and traditional toys, the results of this study revealed that overall, play with traditional toys resulted in similar or higher quality and quantity of language input for children with ASD. Lexical diversity, percentage of pause time, and number of utterances per minute differed in multiple ways, while the amount of words parents produced per minute, as well as parent grammatical complexity (MLU), were similar in both conditions.

Although the previous studies we reviewed did not consider parent MLU as a direct variable (J. L. Miller et al., 2017a; Sosa, 2016; Wooldridge & Shapka, 2012; Zosh et al., 2015), one aspect of parental language input that did not significantly differ between the toy conditions in this study was parental morphosyntactic complexity (MLU). There is extensive evidence that the length of parent input (i.e. MLU) is strongly associated with language outcomes later in life for children with ASD (J. Bang & Nadig, 2015; Choi et al., 2020; Fusaroli et al., 2019; Sandbank & Yoder, 2016; Venker et al., 2015). Given that parental syntactic complexity of speech (MLU) was not significantly different between the toy conditions, this may suggest that both electronic toys and traditional toys may offer similar opportunities for the morphosyntactic complexity of linguistic input to positively affect child language development.

Although this study revealed similar parental MLU, additional aspects of the overall quality of language input were significantly higher during play with traditional toys than play with electronic toys. Parents had more varied language, or higher lexical diversity of parent language (i.e. number of different words) during traditional toy play. Given that parental input with higher lexical diversity is associated with stronger language skills for TD children and children with ASD, this suggests that play with traditional toys may develop stronger language skills in children with ASD (J. Bang & Nadig, 2015; J. Y. Bang et al., 2019). On average, children with ASD were exposed to 16.03 different word roots per minute during traditional toy play, compared to 14.60 different word roots per minute. If we consider child and parent play with traditional toys for just 30 minutes per day, we could expect they may be exposed to an average of 481 different words. Considering this same scenario with electronic toys, children would be exposed to 43 fewer different words (438 different words) during a 30-minute play period. Over a year, this means a child may hear 15,480 more variety/different words during play with traditional toys.

The number of words per minute produced by the parents did not differ significantly between the toy conditions (p = .064), although the trend was for more parental words per minute during play with traditional toys. This is similar to the findings of Zosh et al. (2015), who also observed a higher number of parent words per minute during play with traditional toys for TD children, although this was also not considered significant. In addition, parents produced significantly more utterances per minute during traditional toy play. The results of this study suggest that the amount of parent language input is reduced during play with electronic toys, mirroring emerging evidence that electronic toys and screen time/media result in decreased parental language input and child language output (Lavigne et al., 2011; Zosh et al., 2015).

In addition to producing fewer utterances per minute during electronic toy play, the present study revealed that on average, 8% additional pause time was observed in electronic samples than traditional samples. In total, an average of 24.25% of the play session consisted of pause time with no parent or child speech, although 13.42% of that time was filled with electronic toy speech. Intentional pause time, or wait time, is often encouraged during language interactions for parents to give children additional processing time or opportunities to respond verbally or non-verbally. For example, POWR is a research-based strategy utilized to support social communication needs of students with ASD through four steps: **P**repare the learning experience, **O**ffer opportunity for communication, **W**ait for communication, and **R**espond to communication (Johnson & Parker, 2013). However, we could also consider the amount of pause time to be an indication of the responsiveness or engagement of parents during each play condition. Parent responsiveness that focuses on the child’s focus on attention results in better language and developmental outcomes for both TD children and ASD (Trivette, 2003). Given that there was a higher percentage of pause time for all but two parent-child dyads during electronic toy play (one dyad showed 2% less pause time during electronic toy play, and another remained consistent at 68% pause time), this is likely due to additional words, utterances, music, or noise produced by the toys. In fact, pause time that did not include toy speech was just 10.83% during electronic toy play, which makes it difficult to confirm that the additional wait time observed during electronic toy play would allow for additional processing time.

Similar to findings by Zosh et al. (2015), these results suggest that parents may take a backseat approach during play with electronic toys, including spending more time pausing, using less variety in the vocabulary they use, and producing fewer utterances per minute. The quality and quantity of parental language was higher during play with traditional toys, suggesting that toys without electronic features facilitate higher quality language interactions between parents and children with ASD. Future studies should consider additional variables of parent responsiveness, including joint attention, sustained attention, directed gestures, and/or directed vocalizations from the child participants to further investigate how toy type may affect parental responsiveness. Specific interaction qualities, including caregiver stimulation and sensitivity to the child's interests and attentions, such as imitation, praise, and shared engagement, has been shown to be an important predictor of early vocabulary and later language skills for TD children (Bradley et al., 2001; Rodriguez & Tamis-LeMonda, 2011; Vallotton et al., 2017). These variables should also be further investigated during electronic and traditional toy play to further inform clinicians and caregivers on the effects these toys may have on parent responsiveness.

Considering Toy Speech: Total Language Input

We also considered the total language that children were exposed to from parental language input plus toy speech, similar to Zosh et al. (2015). The results from this study mirrored Zosh et al. (2015) in that the number of total words per minute (parent + toy) the child heard was significantly higher during electronic toy play than traditional toy play. However, in this study, during play with electronic toys, children were exposed to a higher proportion of unique words per minute if we considered both parent and toy language input. Although Zosh et al. (2015) found that children heard a higher proportion of unique words per minute in the traditional play condition, it is not clear if they considered only complete and intelligible utterances or repetitions of toys repeating or interrupting themselves as well. In the current study, only complete and intelligible utterances were considered. However, during observational consideration of the transcripts and videos, there were numerous instances where toy buttons were pushed repeatedly and resulted in nonsense speech. The current study also included multiple sets of electronic toys with varying degrees of words, utterances or music that contributed to overall language input, rather than just one toy.

It is important to acknowledge that the speech produced by the electronic toys should not be considered equivalent to the speech produced by parents. For example, it may be difficult for infants/toddlers to learn vocabulary from nonhuman interactions (Klin, 1992; Kuhl et al., 2005). In addition, language that is child directed, rather than simply overheard, predicts later vocabulary skills (Shneidman et al., 2013) although there is some debate in children with ASD's preference for child-directed speech. Paul et al., (2008) found that toddlers with ASD did show a preference for child-directed speech, although this preference was weaker than TD children's preference for child-directed speech. However, Kuhl et al., (2005) report that children with ASD showed preference for electronically distorted speech, rather than child-directed language input. Children with ASD have also been shown to prefer and attend to musical non-speech stimuli over speech (Dawson et al., 1998; Kuhl et al., 2005).

Even if a particular child does show heightened preference for non-speech stimuli, there are currently no toys that we are aware of, electronic or traditional, that can follow a child's lead to provide the level of parent responsiveness given by caregivers, whose child-directed language often reflects what the child is playing with or interested in.

Auditory Overlap

We hypothesized that more parent utterances per minute would have auditory overlap during electronic toy play than traditional toy play, given that electronic toys produce music and sounds while the traditional toys did not. Results indicated that this prediction was accurate: there were significantly more parent utterances per minute with auditory overlap (from either the child or the toys) during the electronic toy play condition than the traditional toy play condition. In fact, during play with electronic toys, parents' speech was overlapped more than 3 times the amount of overlap observed during play with traditional toys. Parents averaged 18.65 complete and intelligible utterances per minute, with 3.15 utterances per minute competing with auditory overlap. If we consider that as a percentage of auditory overlap, approximately 17% of parents' complete and intelligible utterances were overlapped with child vocalizations and/or toy noise. During play with electronic toys, on average, parents produced significantly fewer complete and intelligible utterances per minute (M=16.25) and auditory overlap was significantly higher (M=8.68). Play with electronic toys yielded 53% of parent utterances with auditory overlap from the child speech/vocalizations and/or toy noise.

The fact that more than half of complete and intelligible utterances spoken by parents during this study had competing auditory overlap during play with electronic toys is concerning. As discussed, previous literature has shown that children with ASD often exhibit atypical processing of auditory information, including impaired processing of speech when there is auditory overlap present (Dunlop et al., 2016; Nishi et al., 2010;

O'Connor, 2012). Specifically, children with ASD have been shown to have heightened awareness of environmental noise compared to TD peers, as well as enhanced pitch perception (Kuhl et al., 2005; O'Connor, 2012). This atypical processing of auditory information may lead to impaired processing of linguistic information provided by caregivers in their linguistic environment (O'Connor, 2012)

In the current study, we considered auditory overlap as one variable to include both toy speech (i.e. words/utterances spoken by the toys) and toy noise (e.g. music, sound, etc.). However, researchers have also considered background noise as two broader categories: background *speech* and background *noise*. Although both have been shown to have a negative impact on both TD children and children with ASD's ability to recognize and process speech and language, background speech in particular has been shown be more disruptive to language processing skills. Future research should separate these conditions of auditory overlap to provide additional insight into the type of background noise that electronic toys may be introducing.

Clinical Applications

There is anecdotal and empirical evidence that children with ASD may prefer electronic toys that provide additional sensory components or musical non-speech stimuli (Dawson et al., 1998; Kuhl et al., 2005). Electronic toys may be an excellent tool to support external motivation or to encourage joint attention. However, these suggestions should be considered carefully, as toy speech/language alone has not been shown to directly improve language development for TD children or children with ASD. For example, Wooldridge and Shapka (2010) found that during play with electronic books, no child imitated a word given by the book. In addition, children were only observed responding to a request by the book (e.g., ”Where is …”) when the request was repeated by their caregiver. Although caregivers may have the best intentions to provide their children with electronic toys that are marketed as educational, these claims should be considered with caution. We saw that during natural play, parents were more likely to “let the toys do the talking,” in a sense, significantly increasing pause time, decreasing lexical diversity, and reducing the number of utterances produced per minute during play with electronic toys.

From a clinical perspective, speech-language pathologists advocate for rich language input from caregivers for young children who are learning language. Given additional training, it is plausible that parents could learn to provide the same level of rich language input during play with electronic toys. The fact that parental grammatical complexity (MLU) did not differ significantly between the toy conditions shows some promise that the language gap we observed during play with the two toy conditions could be bridged. However, even if parents provided the most grammatically complex or lexically diverse language appropriate for their child, auditory overlap may distract a child from hearing and processing this language input (Ludlow et al., 2014). These findings discourage the sole use of electronic toys during play given more than half of parental utterances were competing with increasing background noise from the toys.

Strengths and Limitations

The primary limitation of the current study was its relatively small sample size. It will be crucial to explore these research questions with a larger sample of children with ASD, which will offer increased statistical power and allow broader generalization of the results. Future studies could also consider family socioeconomic status (SES). Hart and

Risley (2003) found that TD infants with high SES parents were exposed to significantly higher caregiver speech and had better vocabulary skills at 3 years ago compared to infants from lower SES parents. In fact, they estimated that by 3 years of age, low SES children hear 30 million fewer words than high SES children (Hart & Risley, 2003).

Despite these limitations, there are several strengths of this study. The study design included a within-subjects experimental manipulation, with each child serving as their own control. In addition, high ecological validity was demonstrated, given that parents were encouraged to play with the children as they would at home, with the goal of mirroring everyday play activities parent-child dyads may engage outside of a controlled laboratory setting. Future studies could also take into consideration the type of toys that children typically play with at home.

Conclusion

To our knowledge, this study is the first to examine the impact of electronic toys on the quality and quantity of parent speech provided to children with ASD. Building on previous evidence of parental language input during play with electronic and traditional toys for TD children, this study revealed that the type of toy did influence overall the quality and quantity of parent language input for children with ASD in undesirable ways. When playing with electronic toys, parents of children with ASD produce fewer utterances, spend more time not speaking (i.e., pausing), and use a less lexically diverse vocabulary. In addition, significantly more parent utterances were obscured by background noise during electronic toy play than traditional toy play and may decrease processing of language input for children with ASD. Though electronic toys may have some advantages, such as increasing engagement in young children with ASD, the potential tradeoff concerning the quality and quantity of parent input must also be carefully considered.

APPENDICES

APPENDIX A: Summary of SALT Transcription Rules

Contents

Transcription Resources

Reference documents found at http://saltsoftware.com/resources/tranaids

- Summary of Transcription Conventions
- Summary of C-unit Segmentation Rules

Help built into SALT software

- F1 key for context-specific help (*provides transcription conventions while in editor*)
- User Guides accessible from the Help menu

Lingo Lab SALT Training: Each person will need to create an account in SALT (saltsoftware.com).

Self-Paced Online Courses: https://classes.saltsoftware.com/

1301	Transcription-Getting Started	1 hr
1302	Transcription-Transcript Format	1 hr
1303	Transcription-Utterance Segmentation	1 hr
1304	Transcription-Conventions Part 1	1 hr
1305	Transcription-Conventions Part 2	1 hr
1306	Transcription-Conventions Part 3	1 hr
1308	Transcription-Practice Samples	1-3 hrs

SALT You Tube Videos

Video Topic	Length
SALT Software-Create and Save a File: SALT20	4:29
SALT Software-Past Tense ed and en	4:21
SALT Software-Gerunds vs. Verbs ending with -ing	3:50

Communication Unit (C-Unit) Utterance Segmentation

Communication units are defined as "an independent clause and its modifiers". In other words, a C-unit includes one main clause with all subordinate clauses attached to it. A communication unit is an utterance that cannot be further divided without the disappearance of its essential meaning. Subordinate clauses depend on the main clause to make sense. They cannot stand alone or be separated from the main clause.

A clause, whether it is the main clause or a subordinate clause, is a statement containing both a subject and a predicate. Grammatically, a subject is a noun phrase and a predicate is a verb phrase.

Helpful Tips

<u>Conjunctions</u>: Below is a list of common coordinating and subordinating conjunctions that may help in understanding C-units. Coordinating conjunctions alert us that the utterance can stand alone as a separate C-unit. However, if an utterance contains a subordinating conjunction, the utterance should not be separated into separate C-units because a) the essential meaning would change, and b) dependent clauses cannot stand alone.

- Coordinating Conjunctions (signals to segment into new C-unit)
  and, but, or, and then, then, so (not "*so that*")
- Subordinating Conjunctions (do not segment into new C-unit)
  Early development: *because, that* ("*that*" may also be an implied subordinator), *when, who*
  Later development: *after, before, so that, which, although, if, unless, while, as, how, until, as__as , like, where*

<u>Pauses and intonation</u>: Do not ignore pauses (at least 4 seconds) and intonation when segmenting utterances but, whenever reasonable, segment utterances based on grammar rules.

<u>Tag Questions:</u> Do not segment questions when they are used as tags.
For example:
C They got in trouble, right?

C He miss/ed the bus, did/n't he?

Rules and Examples

For comprehensive rules with examples, download the "Summary of C-unit Segmentation Rules" at http://saltsoftware.com/resources/tranaids

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A. Transcript Format

Line identifiers. Each entry must begin with one of the following identifiers:

$	Identifies speakers
+	Header information, e.g., demographics
C or E or ..... other	Speaker identifier
=	Transcriber comment
; or :	Between-utterance pause
-	Timing line

For the Lingo Lab, when starting a new transcript you should enter:

Target Speaker: Child
Other Speakers: Parent
Participant Id: Study ID
Name or initials: *Leave blank*
"Gender": Enter child's gender
Don't enter: Date of birth, date of sample, grade, ethnicity, parent education
Examiner's name: *Leave blank*
Transcriber's name: Enter your initials
Sampling Context: Con, Play
Target Language: English
Location: Lingo Lab

Then the transcript should look like this:
$ Child, Parent
+ Language: English
+ ParticipantId: 4111
+ Gender: M
+ Context: Con

+ Subgroup: Play
+ Location: Lingo Lab
+ Transcriber: KRP
- 0:00

Ending punctuation. All utterances must end with one of the following punctuation marks:

. ! ?	Statements, exclamations, questions
>	Abandoned utterances
^	Interrupted utterances
~	Intonation prompts

Timing Lines.
Mark beginning and ending time. SALT uses timing lines to calculate elapsed time and speaking rate. Begin timing lines with a hyphen followed by the elapsed time in :sec, min:sec, or hours:min:sec.

Transcriber Comments
= Comment lines begin with an equal sign. For the Lingo Lab, = will be used for gestures (e.g., = Child waves bye bye), play actions (e.g., = Child throws the ball), contextual information (e.g., = RA comes in to adjust the camera), or vegetative sounds like clearing one's throat, coughing, or sneezing (e.g., = Adult sneezes)
{ } Comments within utterances are enclosed within braces. Braces can stand alone OR within or adjacent to an utterance. For the Lingo Lab, braces will be used for vocalizations that may function as part of a communicative interaction, including:

Sound effects C {howling wolf sound}.
Laughter C {laughs}.
Vocalizations C {voc}. (Vocalizations differ from unintelligible utterances)

Also, if an AAC device is used, record the output, but do so as a comment (with "=").

Example: P What do you want?
= AAC device says, "cookie"

Example of transcript format:

$ Child, Examiner

+ Name: Chance
+ Gender: M
+ CA: 8;1
+ Context: Nar
+ Subgroup: SSS
- 0:00

C (Um) he/'s the guy that (make/3s) make/3s hay out of (go*) gold.
C And (he he he) he use/3s (um) something to spin it around with because (um) the king only (was was was) was greedy.
C So he said this will (m*) make the hay out of gold.
:03
E Can you tell me what happen/ed first in the story?
C (Um :04) well there was something XX {whispers}.
= lots of background noise
C And he jump/ed up and down and say[EW:said] "no, no, that was/n't his name".
C But at the end (he) she said "(is her na*) is his name (Rump*) Rumpelstiltskin"?

.....

C And that/'s all.
- 3:12

C. Bound Morphemes

Format: use the root form of the word followed by the bound morpheme, i.e., root/bm.

1. Plurals and Possessives

- /S for plurals, e.g., *dog/s, story/s*
  - **Do not mark plurals if there isn't a singular form, e.g., *news, tidings***
  - **Do not mark irregular forms, e.g., *mice*, *wolves, deer, geese***
- /Z for possessive inflection, e.g., *Mary/z car*
  - Do not mark possessive pronouns, e.g., *mine,* ***his, hers, its, ours, yours, theirs***
- /S/Z for plural and possessive, e.g., *baby/s/z names*

Practice #2: Bound Morphemes – Plurals and Possessives

2. Verb inflections

- **/ING for present progressive**

- As a rule of thumb... present progressive verbs, which are marked as bound morphemes, typically follow an auxiliary "be" verb (is, are, am, was, were, be, been). Use the root form of the verb followed by the bound morpheme "/ing".
  Examples:
  He is swim/ing at the lake.
  Are they swim/ing now?
  They were make/ing a cake.
  They/'re leave/ing soon.

- Gerunds, which end in -ing, should not be marked as a bound morpheme. Gerunds function as nouns, i.e., gerunds function as subjects, direct objects, indirect objects, and objects of prepositions.
  Examples:
  Dave enjoys **swimming** more than any other sport.
  They went **swimming**.
  I dream about **winning**.
  I look forward to **going** home.
  Hint: If an "-ing" word follows a preposition, it is a gerund.

Practice #3: Bound Morphemes – Present possessive & Gerunds

- **/ED for regular past tense**, e.g., *look/ed, stop/ed, try/ed, believe/ed*
  - Do not mark irregular forms, e.g., *were, saw, went, had, made*
  - Past participles, passive forms, and predicate adjectives
    Although sometimes confused with past tense verbs, these forms are not verb forms and the -ed at the end of these words are NOT marked as bound morphemes. For example,
    Past participles: Her hair was well **brushed**. She was **tired**. The porcupine was **named** Fluffy.
    Passive forms: The store was **robbed** last night. The vase is **smashed**.
    Predicate adjectives: The grape/s became **shriveled** in the sun. I like car/s **produced** in Japan.

    Hint: regular past tense /ED verbs never follow a BE or GET verb.

Practice #4: Bound Morphemes – Regular past tense

- /3S for 3rd person singular verb forms, e.g., *she run/3s*
  - **Do not mark irregular forms, e.g., *has, was***
  - **Do not mark forms if the sound of the root changes, e.g., *do à does***

- **/EN for <u>past participle</u>**, e.g., *take/en, eat/en, prove/en*
  - Do not mark irregular forms, e.g., *gotten, spoken, seen, been*
  - **Do not mark forms if the sound of the root changes, e.g., *write à written***

Hint: regular form is present tense + EN as a separate syllable. /EN verbs always follow a HAVE verb.

Practice #5: Bound Morphemes – 3rd person singular (/3s) & Past participle (/en)

4. Contractions

- /'T, /N'T for negatives, e.g., *can/'t, did/n't, is/n't*
  - **Do not mark forms if the sound of the root changes, e.g., *do à don't, will à won't***
  - **Do not mark the word *ain't* as there isn't a non-negative form**
- /'LL, /'M, /'D, /'RE, /'S, /'VE for contracted "will", "am", "would", "are", "is", "have"
  Examples: *they/'ll, I/'m, she/'d, we/'re, he/'s, we/'ve*
- /H'S, /H'D, /D'S, /D'D, /'US for contracted "has", "had", "does", "did", "us"
  Examples: *He/h's been sick.*
  We/h'd better go.
  What/d's he do for a living?
  Why/d'd he leave?
  Let/'us go.

Practice #6: Bound Morphemes - Contractions

D. Spelling conventions

Since each word with even a slightly different spelling appears as a different word in SALT analysis, it is important to follow standard spelling conventions to ensure consistency within and between transcripts.

- <u>Abbreviations</u> should either be spelled out or left as an abbreviation but WITHOUT the period, e.g., *Mr, Mon, Monday*. Periods may only be used to mark the end of an utterance.
- <u>Yes words</u>: *ok, aha, mhm, uhhuh, yeah, yep, yes*
- <u>No words</u>: *no, ahah, mhmh, uhuh, nah, nope*
- <u>Hyphenated words</u> follow standard spelling conventions, e.g., *mother-in-law, pick-me-up*.
- <u>Numbers and dates</u>: You should transcribe numbers and dates as a single word in either written form or as digits, e.g., *21 or twenty-one*, *Aprilcon13_2018* or *4-13-2018*. Choose a format and be consistent.
- <u>Clock time</u>: Do not use colons when transcribing clock time because colons will be interpreted as pause times. Type out the words connected with an underscore, e.g., *eight_thirty, five_oclock*

- <u>Counting and “spelled” words</u> use the underscore to connect the numbers or letters, e.g., 1_2_3_4_5, C_A_T
- <u>Concatenatives</u>: Words, such as gonna, wanna, and hafta, occur when the syllables of common words are blended together. Transcribe concatenatives as a single word.

betcha (bet you)	*liketa* (like to)	*outta* (out of)	*useta* (used to)
coulda (could have)	*lookit* (look at it)	*shoulda* (should have)	*wanna* (want to)
gonna (go/ing to)	*musta* (must have)	*sposta* (suppose to)	*whatcha* (what are you)
gotta (got to)	*oughta* (ought to)	*trynta* (trying to)	*woulda* (would have)
hafta (have to)			

- <u>Other Shortened Words</u>: If the speaker says *'cuz* instead of *because*, either type out the full word *because* or use the vertical bar to identify the word. In the following example, the speaker said “cuz”. No matter which form you use, the word root in this example is analyzed as “because”.
  Example: *He was sad because they left.*
  He was sad cuz|because they left.
- <u>Proper Names and Titles</u>: Enter proper names or titles as a single linked word, joined together with the underscore character, e.g., "Little Red Riding Hood" should be transcribed as *Little_Red_Riding_Hood* and "Grandma Jones" should be *Grandma_Jones*. When words are linked, they are counted as a single unit (word) in SALT analyses.
- <u>Idiosyncratic Forms</u>: Young children often produce speech that differs from the adult version. Although these idiosyncratic forms are not adult-like productions, they are stable productions by the child rather than babbling, mispronunciations, or word errors. When transcribing idiosyncratic forms, enter a percent sign (%) at the beginning of the idiosyncratic form. For example,
  C My %vroom {car}.
  E Would you like a cookie?
  C %coopa {cookie}.
- <u>Sound Effects</u>: Sound effects are non-word vocalizations which represent specific sounds such as those made by an animal, e.g., *meow*, or an object, e.g., *vroom*.

○ If the sound effect is word-like (e.g., moo, honk), transcribe it as a word.
  C The dog went woof.
  C Then the boy heard ribbit {repeats 1x}.

○ If the sound effect is not word-like (e.g., howling sound, alien sounds), put it in braces either with an existing utterance or as a stand-alone turn.
  C The dog growl/ed {child makes growling sounds} at them.
  C They fell down {child makes falling down noises}.

or

P It/’s an alien!
C {odd alien sounds}.

or

P It/’s a doggie!

C {barking dog sound}.
or
P It/’s a doggie!
C Woof {repeats 1x}!

- Sounds with specific meanings: *hmm, mmm, huh* (question or affirmation), *IDK* (intoned *I don’t know*), *uhoh* (something is wrong), *shh* or *%shh* (be quiet), *psst* or *%psst* (to get someone’s attention), ahh (as in, “I see!”)
- Other spellings: *ain’t, alot, atta, no one, oh, ooh, oop, ope, oops, oopsy, woah, oh no* (keep separate)*, ok*

E. Parenthetical Remarks

A parenthetical remark is a word or clause that has been added by the speaker as an explanation, comment, or request for help. To code parenthetical remarks, enclose them in double parentheses. Parenthetical remarks should be coded if 1) they occur in the middle of an utterance and do not contribute to the meaning of the utterance, or 2) they occur as stand-alone utterances but do not contribute to the content of the sample.

Parenthetical remarks which occur in the middle of an utterance
When a parenthetical remark occurs in the middle of the utterance does not contribute to the rest of the utterance, enclose it in double parentheses. For example,
C The boy ((I can/'t remember his name)) left the house.
C Then the ((what/'s that call/ed)) < > gopher bit him on the nose.
E <gopher>.

Parenthetical remarks which occur as stand alone utterances
When a parenthetical remark occurs as a stand-alone utterance, you need to decide whether or not you want that utterance included when analyzing the sample.

For conversational samples, you may want these utterances included as they occur naturally in conversation. For example,
C Last weekend I went to my grandma/z house.
C I forgot what I was go/ing to say.
E What did you do at your grandma/z?

For story retell and expository samples, however, you may not want them included unless they contribute to the content of the narrative. For example,
C ((I skip/ed a page)).
C (((Where) where was I))?

C ((Can I stop now))?

F. Unintelligibility

Unintelligibility can be the result of many things, including the speaker turning away from the microphone or speaking too softly, equipment failure, or background noise. It can also be caused by the speaker's phonological difficulties or due to an unfamiliar listener's perception. As a general rule, if you cannot understand all or part of an utterance after listening three times, it should be marked as unintelligible.

Marking Unintelligible Segments: Use an X to mark an unintelligible word. Use XXX when the entire utterance is unintelligible. And use XX to mark a segment longer than a single word but shorter than the entire utterance. Note that it is often difficult to distinguish whether the unintelligible segment consists of a single word, multiple words, or the entire utterance (after all, it's unintelligible).
Example *1*: unintelligible word
C He X away yesterday.
Example *2*: unintelligible segment, somewhere between a single word and the entire utterance.
C He XX yesterday.
Example *3*: unintelligible utterance
C XXX.

G. Mazes (filled pauses, repetitions, revisions)

Filled pauses**.** Words or vocalizations that fill in pauses should be placed in parentheses. Standard fillers include: (*AH), (EH), (ER), (HM), (UH), (UM)*. Nonstandard fillers should be coded as [FP], e.g., (*like[FP]), (you_know[FP])*.

Part-words. Use an asterisk to replace the portion of the word that is missing when a speaker fails to complete a word, e.g., *(b* b*)*. This form is used to mark stuttering as well as part-word revisions. Unless part-words occur at the end of an interrupted or abandoned utterance, they are treated as maze components and are parenthesized. To mark stuttering in the middle of a word, separate the parts of the word, before and after the stuttering, with underscore characters, e.g., *hap_ (p* p*) _py*.

Repetitions or revisions. The speaker's final expressive attempt is considered the resolved utterance, and the earlier attempts are mazed. All repetitions and revisions should resolve themselves so do not end an utterance with a repetition or revision unless the utterance is abandoned or interrupted.

If words are repeated as part of a sound effect, write the word once, then put in brackets how many times it repeated after that.

Example: Woof {repeat 1x}.

If any overlapping utterance begins after the beginning of repeated sound-effect words, treat the repetitions as a single word and show it as overlapping.

Example: C <Beep> {repeat 10x}.
P <Huh>?

<u>Adjacent mazes</u>. Combine adjacent mazes into a single maze.

Examples:
C And then (um he went) he went to the park.
C And (when the b*) if the batter hit/3s the ball, he run/3s (to um) to first base.

Practice #7: Mazes (filled pauses, repetitions, revisions)

H. Overlapping speech and Interjections

Transcription is linear but sometimes the language sample is not. Use angle brackets < like these > to mark the overlapping speech in both speakers' utterances.

Example: E Which book do you want <to read>?
C <This one>.

If there's a word with an overlap beginning at the end of the word, count the whole word as overlapped with <> around the word. If there is a string of vocalizations (not separated by at least 2 seconds or another utterance) from the child, and the parent begins an utterance during any of the vocalizations, overlap the vocalizations with the parent utterance.

Example: C <{voc}>.
= String of vocalizations
P <A doggy>?

If there is more than a single utterance overlapping with another speaker's single utterance, wrap all the overlapping utterances with <>.

Example: C <{voc}>.
= Very long vocalization
P <That's blue>.
P < Look>!

Use empty angle brackets < > for interjections that occur within the other speaker's utterance but do not overlap the speech.

Example: C I don't want it < > anymore.
E <Ok>.

Practice #8: Overlapping speech & Interjections

I. Pauses (unfilled)

Enter the length of each significant pause (4 seconds of complete silence or longer) at the point where it occurs in the transcript. Pause length is measured to the nearest second.

<u>Pauses within utterances</u>

Enter the length of the pause in seconds at the position in the utterance where it occurs. Pause time should be separated with a blank space from any adjacent words. If the pause occurs immediately before or after a maze, include it within the maze. For example,

C The movie :04 was (um :05) Batman.

<u>Pauses between vocalizations</u>

If there is a 2-second pause between vocalizations or another utterance, separate those vocalizations into separate utterances. If there is a pause less than 2 seconds and no other utterances between, count them as one vocalization, or identify them as a string using the = to comment.

Example: C {voc}. *(You hear 2-second pause)*
C {voc}.
P How about that?
C {voc}. *(You hear several voc's without 2-second pauses)*
= String of vocalizations
C {voc}. *(You hear a 2 second pause between this utterance and the last)*

Pauses between utterances

Format pause in seconds or minutes:seconds. If the pause occurs between utterances of different speakers, begin the pause line with a colon. If the pause occurs between utterances of same speaker, you almost always begin the pause line with a semicolon. You would only begin a pause line with a colon if you want to force a turn change.

Pause time may be entered as:

:sec	or	;sec	{ *this simplified format was introduced with SALT 18* }
: :sec	or	; :sec	
: min:sec	or	; min:sec	

Practice #9: Pauses (unfilled)

J. Omissions and Errors

Omissions

An omission occurs when one or more words or bound morphemes that are obligatory for grammatical correctness are absent. For example, if the speaker says, "His name Larry", the copula "is" should be marked as an omission. On the other hand, if the examiner asks, "What are you doing?" and the speaker responds "Eating", there isn't an omission because no obligatory content was left out.

- *Omitted Words*
  The asterisk symbol (*) is used to indicate an omitted word. At the point in the transcript where the word was omitted, type an asterisk followed by the omitted word. There should be no blank spaces between the asterisk and the omitted word. For example,
  *This *is a cookie.*

- *Omitted Bound Morphemes*
  A slash followed by an asterisk is used to indicate the omission of a bound morpheme in obligatory context. Type the slash, the asterisk, and the missing bound morphemes at the point in the transcript where they've been omitted. For example,
  *The car go/*3s here.*

- *Omitted Contractions: Words vs Bound Morphemes*
  Omitted contractions may be transcribed in two ways, as an omission of a word or as an omission of a bound morpheme. It doesn't make much difference which way you mark this type of omission since omissions are not included in any of the calculations based

on words or morphemes. The important thing is to mark that the omission occurred. For example,

*She *is leave/ing now.* OR *She/*'s leave/ing now.*

<u>Errors</u>

SALT recognizes a special category of codes called "error codes". These codes are only used to mark errors in syntax and morphology. They are not used to mark errors in semantics or pragmatics. SALT contains a list of default error codes which can be edited to suit your purposes. They include:

[EO:=] overgeneralization error (all codes that begin with "EO:")
[EP:=] pronoun error (all codes that begin with "EP:")
[EW] extraneous word
[EW:=] other word-level error (all codes that begin with "EW:")
[EU] utterance-level error

- *Overgeneralization errors, the [EO:___] code*

  Consider the following examples of utterances containing overgeneralization errors:

  C He **felled**.
  C There were **deers** in the woods.
  C That/'s **hises**.

  To mark overgeneralization errors, first identify these words as instances of the root form, e.g., "*fall*", "*deer*", and "*his*". To identify the root form, follow each overgeneralized word with a vertical bar '|' and the root form. Then insert the code [EO] at the end of the overgeneralized word. Put the target word inside the brackets following a colon:

  C He felled|fall**[EO:fell]**.
  C There were deers|deer**[EO:deer]** in the woods.
  C That/'s hises|his**[EO:his]**.
  C He lookeded|look/ed**[EO:looked]** in a tree.

  Notice, in the first three examples, that the bound morphemes in the overgeneralized words are not marked because we don't want to give the speaker credit for a bound morpheme on a word that is not a real word. In the last example, however, the speaker is given credit for one of the past tense bound morpheme.

- *Pronoun errors, the [EP: ___] code*

  Use this code to mark errors involving personal, possessive, or reflexive pronouns. The correct pronoun is put inside the brackets following a colon. For example,

  C Him**[EP:he]** was sick.
  C So them**[EP:they]** look/ed for the frog.

  Notice that each error code is attached to the specific pronoun that is used incorrectly.

- *Other word-level errors, the [EW] and [EW:____] codes*

Use the code [EW] to mark other words that are used incorrectly. The correct word, if known, is put inside the brackets following a colon. For example,

C The big frog were**[EW:was]** mad.

C They look/ed on**[EW:in]** a hole.

C And then the turtle was of**[EW]** better.

Notice that each error code is attached to the specific word that is used incorrectly. In the last example, the word "of" is an extraneous word; there is no correct substitution.

- *Utterance-level errors, the [EU] code*

  Use the utterance-level error code [EU] to mark the following types of errors:

  - Errors that cannot be associated with a specific word
  - Utterances which contain more than two omissions and/or word errors; to avoid over-correcting them

Insert the [EU] code between the last word and the ending punctuation mark. For example,

C He book [EU].

C And they came stop/ed [EU].

C He was have/ing a frog [EU]?

C The kid tell everything to him happen [EU].

<u>When NOT to mark omissions and errors:</u>

Don't hold the speaker to "grammatically perfect" language. Instead, consider whether or not the language is appropriate for the speaker's age and the context in which it's used. Does the utterance sound ok or does it "sting your ear"? Also, do not mark utterances which contain unintelligible segments since it's possible that the unintelligible segments might have made the utterances acceptable.

Practice #10: Omissions and Errors

Practice #11: Putting it all together – symbols and codes
Practice #12: Putting it all together – sample transcript

How to save your transcript:

- In SALT, go to "File" and click "Save As"
- Under "Desktop," go to "/". Then click "Volume".
- Open "LingoLab" (This takes you to the shared drive)
- Open the "SALT Transcription" folder

- Open “Transcriptions” folder
- Make a folder for the participant with their participant number
- Under these participant folders, name your transcription with participant number, play type, RA initials, and date:
    - 1234_Electronic_KRP_2019.01.02

How to retrieve a past script:

- Open SALT
- Click “Open” when the dialogue box pops up
- Navigate to the “Transcriptions” folder and open up your file

APPENDIX B: Toy Speech

Shape Sorter: Come and say hi. There is fun on five side/s. Hear the animal/s.Beat the drum. The cube is fun for everyone. Explore and learn on every side.
Buttons: Hooray. It/'s the purple drum. It/'s the yellow symbols. It/s the green maraca/s. Beat the drum. Clap the symbol/s. It/'s the green maraca/s. Shake the maraca/s. The cow in the triangle want/3s to sing for you. Moo {repeat x3}. The cow/'s in the triangle. The cat sing/3s meow (repeat x1). The cat in the square is peek/ing out of there. Meow {repeat x3}. The cat/'s in the square. The dog sing/3s woof {repeat x1} {music}.The dog in the star bark/3s and run/3s far. Woof {repeat x3}. The dog/'s in the star. The bird in the circle sing/3s a song. That/'s wonderful. Tweet {repeat x3}. The bird/'s in the circle. Can you find the animal that make/3s this sound? {chirping}. {meow}. {woof}. {moo}.Can you find the instrument that play/3s this sound? {crash cymbals}. {maraca}. {drum beat}.

Songs

- {Row row your boat}.
- {Old McDonald}.
- {Bingo}.
- {Alouette} .
- {Twinkle Twinkle}.
- {My Grandfather's Clock}.

Toy Dog:
Button #1: Hi there! Come for a walk with me. I like to play every day. We can walk. And we can run. I know we/'ll have fun. I/'ll follow you everywhere you go {panting}. I like to sniff {repeat x2} with my nose {sniff noise}. Woof. Yellow. This is my yellow button.I have one nose. One {dog noise}.
Button #2: I have two floppy ear/s. My ear/s perk up when you are near. Woof {repeat x1}. Green {music}. This is my green button {music}. Two {dog noise}.
Button #3: This is my blue button. Blue {music}. {woof}. I have three colorful button/s. I love to play with you every day. Going for walk/s with you is fun. When I/'m excited I like to run. Three {dog noise}.
Button #4: Great! You found my yellow button. You found my green button. You found my blue button. Can you find my yellow button {music}? Can you find my green button {music}? Can you find my blue button {music}? Come for a walk with me. My key/s swing when I move {music}.
Songs

- {This Old Man}.
- {Home on the Range}.
- {Bingo}.
- {Old McDonald}.
- {Camp town Races}.
- {Skip to my Lou}.
- {Daisy Bell}
- {When the saints go marching in}.

Black and White Car: Hear me come/ing. Then see me come/ing.Siren/s ready. I/'m drive/ing to the crime. I/'m Paul. I/'m a proud police car {sirens}. For an emergency dial 9_1_1 to call the police. It/'s my duty to maintain order. P is for police car. Let/'us hurry to stop the crime. The siren on my roof go/3s {woo x1}. I/'m on my way to save the day. I/'m a great police car on the way to stop a crime.

Blue Helicopter: Time to fly {repeat x1}. Fly high in the sky. Fly here. Fly there. Let/'us fly everywhere. I/'m Henry. I/'m a helpful helicopter. H is for helicopter. Control I/'m ready to go. I/'m a helpful helicopter ready to fly anywhere. High in the sky. Wave as I fly by. I/'m flying to the airport. My propeller spin/3s round and round lift/ing me off the ground. I like to fly high in the sky. I will land at the airport.

Red Firetruck: When there/'s a fire I move quickly put/ing up the ladder to help keep you safe from harm. I/'m Frank. I/'m a focused firetruck. When there/'s a fire, dial 9_1_ for help. F is for firetruck. Let/'us go fight the fire. It/'s an emergency. The ladder on my roof is for saving people. The ladder on my roof go/3s way up high. Hurry to the fire. Go!

Barn: Animal/s are a lot like us. They get hungry and thirsty too. They need someone to take care of them. Could that someone be you? There/'s mama cow. She love/3s take/ing care of her baby calf. On the farm there/'s cow/s and pig/s some chicken/s and a horse. Who love/3s take/ing care of them? The farmer does of course. Don't worry piggy. I/'ll clean you up {splashing of bubbles/pig noises}. Brush/ing my horse make/3s his coat healthy. And he love/3s it. Mamma hen has a comfy little nest where she care/3s for her chick/s and take/3s a little rest. I think it/'s go/ing to be a cold night. Let/'us cover the cows in a nice warm blanket. {Moo}. When take/ing care of animal/s there/'s something important to learn. Give them all the thing/s they need. And they/'ll give you love in return. Let/'us bring mama hen and her baby/s some corn from the silo. When you throw the animals down the slide. It/'s a beautiful day to care for the animal/s. The animal/s love Farmville. When the animal/s are happy, I/'m happy. Dinner time!

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