

# The Effects of Mothers' Directive Utterances and Language-Modelling Utterances on the Verbal Behavior of Children with Autism Spectrum Disorder

—A Study Based on Lag Sequence Analysis

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## Abstract

Parent-child verbal interactions are among the most critical factors influencing the conversational behavior of children with autism spectrum disorder (ASD). In this study, we investigated the frequency and sequential patterns of conversational behavior between children with ASD aged 3 - 6 years (n = 40) and their mothers in natural situations. The findings showed that mothers of Chinese children with ASD had 2.06 times more directive utterances than language-modeling utterances. The dominant child behaviors were answers, non-answer, and idiosyncratic conversations. In addition, when mothers used directive utterances, the conversational atmosphere was relatively tense, and it received more non-answer and idiosyncratic conversations along with responses from the children or even diversions to new topics. When mothers used language-modeling utterances, the conversational atmosphere was relatively relaxed, and children's responses were more varied and freer of idiosyncratic conversations.

## Keywords

Children with Autism Spectrum Disorder, Mothers, Verbal Behavior, Lag Sequence Analysis

## 1. Introduction

Autism spectrum disorder (ASD) is a complex neurological pervasive develop-

mental disorder. Its core impairments are deficits in social interaction and communication and stereotypic behaviors (APA, 2013). Previous research has shown that children with ASD have deficits in conversational turn-taking and topic retention during conversations (Landa et al., 1992; Tager-Flusberg & Anderson, 1991). Specifically, these children have difficulty in expanding conversational topics, maintaining appropriate and relevant topics, and engaging in turn-taking compared to non-autistic children and, therefore, rarely engage in peer-to-peer conversations (Bauminger-Zviely & Agam-Ben-Artzi, 2014; Capps, Kehres, & Sigman, 1998; Jones & Schwartz, 2009; Lam & Yeung, 2012; Losh & Capps, 2003). The results of several studies now suggest that early parent-child verbal interaction may be an essential factor in enhancing the language skills of children with ASD (Aldred, Green, & Adams, 2004; Dawson, 2008). For example, some studies have pointed out that the cognitive and language functions of some children with ASD were significantly improved by intensive behavioral interventions starting at preschool age (Ninio & Snow, 2018). In particular, mothers' use of directive utterances and language-modeling utterances has been associated with immediate behavior and long-term language skills in children with ASD (Baker et al., 2010; Haebig, McDuffie, & Ellis Weismer, 2013a; McDuffie & Yoder, 2010). To date, few studies have investigated the causal effects of these two types of conversational utterances by mothers of children with ASD on the verbal behavior of their children.

### 1.1. Directive Utterances

Directive utterances require an explicit response from the child and include, among other things, lead attentional directives, follow-in directives, verbal prohibitions or reprimands, questions, and requests for clarification (Girolametto et al., 2000). Maternal directive utterances have been studied for decades, but the evidence for their association with language development in children with ASD remains inconclusive. Some studies suggested that directive utterances are associated with poorer language outcomes in children (Loveland et al., 1988), but others showed that directive utterances are associated with better language outcomes in children (Akhtar, Dunham, & Dunham, 1991; Haebig, McDuffie, & Ellis Weismer, 2013b; McDuffie & Yoder, 2010). The results of the studies related to each type of directive utterances are presented below.

The directive can be divided into attentional instructions that direct the focus of the child's attention (lead attentional directives) and behavioral instructions that follow the child's attention (follow-in directives) (Pine, 1992; Akhtar et al., 1991). The former directive is seen as a more intrusive directive that may disrupt the child's ongoing activity, while the latter directive is seen as a more supportive directive that attempts to follow the child's current activity and extend it into the behavioral domain. Moreover, some studies showed that the two have opposite effects on children's verbal outcomes (Mahoney, 1992). Therefore, separating these two types of directives is crucial when examining the mother's utter-

ances.

Verbal prohibitions or reprimands refer to using negative commands to stop, manipulate, or manage a child's ongoing behavior (Tulkin & Kagan, 1972). Currently, most studies have focused on comparing the frequency of application of the behavior by mothers of ordinary children in different cultural contexts (Tamis-Lemonda, Sze, Ng, Kahana-Kalman, & Yoshikawa, 2013; Jose, Huntsinger, Huntsinger, & Liaw, 2000). However, little research has been conducted on its relationship with verbal behaviors in children with ASD.

Verbal behaviors theory suggests that questions' and directives' effects on children are primarily compatible (Hubbell, 1977). Questions are another form of directives (i.e., verbal directives) because both convey an expectation from the parent that the child is expected to behave or respond accordingly (Haebig, McDuffie, & Ellis Weismer, 2013a). McDuffie and Yoder (2010) showed that the more mothers' questions (e.g., "What color is that?" "Where is the nose?"), the more receptive the child with autism is to language.

Request for clarification is also a form of questioning. Participants will inevitably encounter misunderstandings or ambiguities in verbal interactions, and in order to keep the conversation moving, mothers often use the act of asking for clarification to ask children to explain themselves accordingly. Early research found that children with ASD generally failed to respond to requests for clarification (Geller, 1998). However, Volden (2004) investigated conversation repair in high-functioning children with ASD and nine language-matched regular children to determine whether they could respond to a request for clarification (a repair strategy) in the context of a communication disorder. By coding responses to requests for clarification, the researchers found that children with ASD could recognize the need to repair communication failures and used a range of strategies to do so, although the ASD group also had more inappropriate responses.

## 1.2. Language-Modeling Utterances

Language-modeling utterances refer to utterances that is responsive to children's utterances (Girolametto et al., 2000) and is also referred to as reactive utterances (Girolametto, Sussman, & Weitzman, 2007). These utterances are characterized by input behaviors that are child-centered (Matychuk, 2005; Snow, 1972, 1995). These behaviors include imitations, recasts, descriptions or comments, labels, and affirmation or support from the mother. Some research has found a positive correlation between most language-modeling utterances and language outcomes in children with ASD (McDuffie & Yoder, 2010; Siller & Sigman, 2002). The effects of these subcategories of language-modeling utterances on the language abilities of children with ASD are described below.

When mothers use labels (tags), descriptions, or comments on objects in the environment (without requiring children to respond), they can provide children with rich language input that allows children to make connections between words and objects (Girolametto & Weitzman, 2002; Hoff & Naigles, 2002). In

McDuffie and Yoder's (2010) and Siller and Sigman's (2002, 2008) study, it was found that when parents used more follow-up comments (describing the child's focus of attention but not asking the child to respond) predicted the language ability of children with ASD after three years.

There are some similarities between imitations and recasts. Simply imitating the child's previous words may help maintain the child's attention and support comprehension (Sokolov, 1993). Recasts are adding to the child's previous utterances and structurally changing one or more components and may involve rearranging or expanding the child's utterances (Fey & Proctor-Williams, 2014; Nelson, Camarata, Butkovsky, & Camarata, 1995), which allows children to develop more advanced language models by contrasting their own utterances with more advanced adult utterances. In addition, another reason why recasting is thought to help children's language development is that it does not force children to respond. This gives children time to adjust rather than spending all their attentional resources on answering (Fey & Proctor Williams, 2000).

Maternal affirmation or support may help create a warm environment conducive to language learning, but to our knowledge, the link with language outcomes in children with ASD has not been investigated. Praise is also an expression of maternal affirmation or support, and parental praise has been used as a marker of positive parenting behaviors in many studies (Breitenstein et al., 2012; Chorpita, Daleiden, & Weisz, 2005). Although there is some debate about whether excessive use of praise negatively affects children's intrinsic motivation (Owens, Slep, & Heyman, 2012), there is now a large body of research showing that the strategic use of praise enhances children's feelings of confidence (Brummelman et al., 2014; Cimpian, 2010; Henderlong & Lepper, 2002; Zentall & Morris, 2010).

In summary, the significant difference between directive and language-modeling utterances is that the latter is child-directed, consistent with the child's current interests and language skills, and does not require an explicit response or "performance" from the child. (Girolametto et al., 2000; Murray & Hornbaker, 1997; Roberts & Kaiser, 2011). By reviewing the above literature, it is clear that directive utterances may further limit the opportunities for children with ASD to improve their communication skills, so children with ASD may require a higher proportion of language-modeling utterances to achieve maximum improvement in communication skills compared to normally developing children.

### 1.3. Deficiencies of Previous Studies

Although there are many pioneering studies in this area, they all suffer from the following two problems.

First, no causal conclusions can be drawn. Most of the parent-child studies we reviewed fall into two broad categories. In one category, only the mother's interactive behaviors were observed and then correlated with the child's linguistic productivity (language productivity), as measured by specialized scales: the MCDI (McDuffie & Yoder, 2010), PPVT-R (Chang & Luo, 2020), MSEL (Venuti

et al., 2012); test scores (receptive and expressive language) (Drew et al., 2002) or expressive language skills (volume of words, total vocabulary, the average length of utterances, et al.) (Blom et al., 2020; Venuti et al., 2012) Another category is that both mother's and child's behaviors are counted or coded and correlated with each other, possibly also with other measures and variables (Jones & Schwartz, 2009). A problem common to both types of studies is that data analysis using correlational methods does not allow causal conclusions to be drawn.

Second, the interactivity between parents and children is ignored. The earliest studies of parent-child interaction primarily examined parents' influence on their children. However, current theory increasingly emphasizes that children bring important input to the interaction, suggesting that the relationship is not static but communicates in a mutually regulated, dynamic, and adaptive dialogue (Bretherton, 1992). Considering that both parents and children can play the role of initiator and responder in a dialogue (Cohn & Tronick, 1988; Fogel, 2009; Kelly & Barnard, 2000), therefore, it is vital to use a tool to measure each other's specific behaviors and to fully describe what each interaction partner brings to the engagement and how these characteristics influence the trajectory of the engagement. Reviewing the published and unpublished behavioral observation tools used to measure parent-child interactions from the 1970s to the present, there is a distinct lack of a tool that provides a comprehensive measure of parent-child interactions.

#### 1.4. Current Study

To address the above questions, the present study used Behavior Sequence Analysis (BSA) to investigate the effects of mothers' verbal interaction behaviors on the conversational behaviors of children with ASD. Behavior sequence analysis, also known as Lag Sequence Analysis (LSA), is an effective method for understanding the dynamic interactions between complex behavioral chains. In LSA, behavioral chains are parsed to identify individual behaviors and behavioral shifts (Bakeman & Gottman, 1997; Clarke & Crossland, 1985). These behaviors are designated as specific codes that are recorded in the order in which the events occur (Keatley, 2018). The sequence of behavioral codes is then statistically analyzed to determine how often behavioral shifts occur and to calculate whether these shifts are significant and occur with a higher than expected probability. Currently, LSA is mainly applied to educational research, such as exploring the action paths of online learners (Hou, 2012), knowledge construction patterns in online forums (Wu & Hou, 2015), or criminal psychology (Ellis, Clarke, & Keatley, 2017; Longridge et al., 2020) and so on. The integration of LSA with language research is still rare. For example, LSA has been used to investigate the association between which repair strategies of mothers and the responses of children with language impairment (Barachetti & Lavelli, 2011; Lavelli et al., 2018) or Molinari, Mamei and Gnisci (2013) using LSA to explore the three-stage sequence of teacher-student initiation-feedback. Thus, this study

aimed to examine the causal effects of mothers' directive and language-modeling utterances on the verbal behaviors of children with ASD using LSA.

## 2. Methods

### 2.1. Subjects

The participants in this study were 40 mother-child pairs of children with ASD who lived in China for long periods and used Mandarin as their daily language of communication and exchange. Demographic information of mothers and children with ASD is detailed in **Table 1**.

The inclusion of children with ASD was subject to the following criteria: 1) all participants had an operational IQ of at least 70, consistent with the criteria of other relevant studies (Siegel, Minshew, & Goldstein, 1996); 2) all participants had no vocal difficulties and had language; 3) the children were diagnosed in the appropriate department of a regular hospital and were diagnosed prior to the study according to DSM-IV criteria (APA, 2013). A validation diagnosis was completed and then judged by at least two experienced exceptional education practitioners, consistent with other relevant research criteria. All families participating in the study had signed an informed consent form.

### 2.2. Corpus Collection

This study used video or audio recording to record the interaction process. Most children used the video method, and individual mothers and children with ASD who did not accept the video method adopted the audio recording method. Most of the situations for the corpus collection were familiar to the children, which was to reduce their anxiety easily induced in the laboratory. In order to ensure the comparability of the interactive data of different children, the timing and content of the video recording were semi-structured. However, the verbal and interactional styles of the interaction were not limited to reflecting the natural daily conversation.

The video time was divided into a warm-up and a formal video phase. Warm-up phase: One of the researchers interacted with the child in the child's preferred

**Table 1.** Demographic information of mothers and children with ASD.

Age group	3 years old group	4 years old group	5 years old group	6 years old group
<b>Children's gender</b>				
Male	10	10	9	9
Female	0	0	1	1
<b>Mother's educational background</b>				
Under college	5	5	5	5
College and above	5	5	5	5

manner to familiarize the child with the researcher until the child's wariness was reduced; the parents were informed to use their usual mode of interaction as much as possible throughout the process. Formal videotaping phase: Formal filming begins when the child and mother are ready. During the formal filming segment, the researcher did not enter into the interaction in any way, ensuring that each mother and child had more than 5 minutes of contextual material in each situation, with 20 minutes of effective material.

For the video (audio) content, the researcher designed three contexts, namely, the free talk context, the drawing context, and the play context. These three contexts basically cover the interaction between mothers and children in their daily lives in terms of play, interaction, and learning, which are the typical basic types of activities between children and mothers. Therefore, the research conducted in these three contexts is representative.

### 2.3. Transcription

The research assistant transcribed the video recordings using Computerized Language Analysis (CLAN) software following the "Codes for the Human Analysis of Transcripts" (CHAT) format in the international Child Language Data Exchange System (CHILDES) (MacWhinney, 2000). This process involved transcribing the language of each child and mother in the video in textual form, marking each utterance individually, and classifying the lexical elements (Chang, 1997) until the entire sample was transcribed. Except for Chinese characters, all symbols were displayed in English and converted to text files that could be run in CLAN.

### 2.4. Coding

The coding categories used for mothers were mainly derived from Girolametto et al. (2000) and based on categories used in previous literature (Konstantareas et al., 1988; Pellegrino & Scopesi, 1990; Tulkin & Kagan, 1972; Tulviste, 2004). Some modifications were made and are listed in **Table 2**.

Children's language development requires acquiring conversational skills such as initiating, maintaining and repairing topics. (Capps et al., 1998; Loveland et al., 1988; Volden, 2004). The present study considers conversational skills from the perspective of conversation skills. In this study, children's behaviors were coded from the perspective of conversational skills: invitation, answers, expands, and repairs. In addition, considering that children with ASD have difficulties in all of these areas, that is, children with ASD often fail to cooperate with conversations and appear to respond inappropriately or not, Non-answer and idiosyncratic conversation (idiosyncratic answers, idiosyncratic expands, idiosyncratic repairs) in children with ASD were also coded. (**Table 3**)

### 2.5. Data Analysis

We used LSA to explore patterns of mother-child interactions. LSA is a helpful

**Table 2.** Mother's verbal behavior coding.

Dimensionality	Code	Explanation	Example
<b>Directive utterances</b>	<b>M1</b> lead attentional directives	Words that direct the child's attention to an object or activity, or calling the child's name to get the child's attention" (Girolametto et al., 2000).	"Look here"/"Julian"/ "Let us see what's in the bag."
	<b>M2</b> verbal prohibitions or reprimands	Utterances that uses negative commands to interfere with or prevent behavior has already begun (Tulkin & Kagan, 1972); and words that scold, condemn, punish, criticize, warn, or exhort the child (Girolametto et al., 2000).	"Stop," "Don't do that," "No," "Don't put it in your mouth." "Stupid," "Mom doesn't like you at all."
	<b>M3</b> follow-in directives	Words that command, suggest, or instruct a child to play in a certain way or demonstrate a specific behavior (Girolametto et al., 2000; Tulviste, 2004).	"Come"/"Please take it out of your mouth." "Watch out"/"Watch out"/ "Wait"/"Give me a duck."
	<b>M4</b> questions	The mother asks the child a question to elicit an answer (Konstantareas et al., 1988)	"Do you like to swim?"/ "What color is this?"
	<b>M5</b> request for clarification	Asking the child to clarify the meaning in the preceding utterances (Girolametto et al., 2000).	Example 1, C: "The park." M: "Is he going to the park?" Example 2, "Are you sure?" "Hmm?"
<b>Language-modelling utterances</b>	<b>M6</b> labels	Short utterances for tagging objects (Girolametto et al., 2000).	That's X/This is X/Red X/You have X.
	<b>M7</b> imitation	Adults completely or partially imitate the child's words (Girolametto et al., 2000; Konstantareas et al., 1988).	Example 1, C: "banana" M: "banana". Example 2, C: "I want to eat" M: "Eat."
	<b>M8</b> recasts	The mother repeats the preceding child's approximation or verbalization and completes the pronunciation by adding one or more morphemes or words (Girolametto et al., 1999).	Example 1, C: "pasta" M: "spaghetti" Example 2, C: "Eye" M: "Eye, yes."
	<b>M9</b> descriptions or Comments	Words describing the child's or mother's own activities (Girolametto et al., 2000).	"You built the house."/ "I'm making cookies."
	<b>M10</b> affirmation or support	Adults assess the child's behavior positively (encouraging, praising, and supporting ongoing activities) (Girolametto et al., 2000).	"Yes"/"That's a beautiful drawing"/"It's OK."

Note: M: Mother; C: Child.

**Table 3.** Children's verbal behavior coding.

Code	Explanation	Example
C1 invitation	New topics are inconsistent with the previous ones and have a sense of sharing (Reichle, Longhurst, & Stepanich, 1976).	Example 1, M: I have flowers. C: Mom, what is that? Example 2, M: This is a lamb. C: What's in the kitchen? Example 3, M: Here is the carriage. C: The door is closed (the door of the carriage)
C2 answers	The child responded to the mother's question within five seconds (Grelle, 2013) /or repeated or partially repeated the mother's words	Example 1, M: What color is it? C: Blue. Example 2, M: Go to the beach in the afternoon. C: The beach. Example 3, M: Mom is here. C: Here.
C3 expands	Provide at least one new piece of information about the topic currently under discussion (Fivush & Fromhoff, 1988).	Example 1, C: Little brother going to sleep - M: going to sleep - C: eyes closed (expanded). Example 2, C: This is a fish - C: Small fish swimming (expanded).
C4 repairs	The child adds to his or her own or his or her mother's words.	Example 1, M: Where is the kitchen? -C: Over here -C: This side is all kitchen (repair). Example 2, C: xxx -M: What did you say? -C: calf (repair). Example 3, C: Crying - M: Who is crying? -C: Doll (mend).
C5 non-answer	The mother asks a question, and the child does not answer within five seconds without answering (Grelle, 2013).	Example 1, M: What are you doing? -C: 0. (child does not answer within five seconds)
C6 idiosyncratic conversation	Words that do not fit the subject matter or are incomprehensible (Zambrana, 2007).	Example 1, M: Look at the beautiful fish mom drew -C: To give it a place to live (idiosyncratic conversation) Example 2, M: Do you like it? -C: Eat, eat, eat, eat, eat. (idiosyncratic conversation)

Note: M: Mother; C: Child.

tool for researchers to analyze linear relationships of behaviors and extract patterns. It also allows researchers to examine whether specific behavioral sequences reach a statistically significant level (Bakeman & Gottman, 1997). This study used a tool developed by Bakeman and Quera (Bakeman & Quera, 1995), a LSA tool called General Sequential Querier (GSEQ5.1), to analyze the data.

The process of using GSEQ is divided into the following steps:

- 1) Enter the encoded data into the GSEQ in a specific format.
- 2) The data is compiled with MDS files.
- 3) After the behavioral series analysis, the frequencies and adjusted residual tables are given.
- 4) Plot the behavioral transition according to the adjusted residual table.
- 5) Interpret the results of the data analysis based on the behavior transformation diagram.

## 2.6. Coding Reliability

All transcripts were coded by the author. 20% of the transcripts were randomly selected and independently coded by another coder. Cohen's Kappa statistic was

used to calculate inter-rater reliability for all codes of verbal interaction. The mean of these indexes was 0.96.

### 3. Results

#### 3.1. Behavior Frequency Analysis

When analyzing mother-child interaction behaviors based on the coding system, a total of 26,278 mother-child interaction behaviors were obtained, and the specific distribution is shown in **Table 4**. As can be seen from **Table 4**, the behavior with the highest frequency during mother-child interaction was M3 (4504, 21.12%), followed by M4 (3395, 17.14%), and the results strongly indicate the importance of these two behaviors in mother-child interactions. The three behaviors with the highest frequency in children were C2 (3132, 11.92%), C5 (2784, 10.59%), and C6 (1130, 4.30%), and these results showed the characteristics of children with ASD when communicating to some extent.

Based on the frequency of coded behaviors in **Table 4**, further statistics were done on mother-child interaction behaviors, as shown in **Table 5**. First, the results showed that the ratio of mothers' verbal behavior to children's verbal behavior is about 1.88:1, and the ratio of mothers' verbal behavior to children's non-verbal behavior is even 2.72:1. This showed an unbalanced nature of parent-

**Table 4.** Frequency statistics of verbal behavior.

Object	Behavior name	Frequency	Percentage
Mother	M3	4505	21.12%
	M4	3395	17.14%
	M9	3135	11.93%
	M10	948	3.61%
	M7	882	3.36%
	M2	610	2.32%
	M5	582	2.21%
	M6	440	1.67%
	M1	325	1.24%
	M8	205	0.78%
Children	C2	3132	11.92%
	C5	2784	10.59%
	C6	1130	4.30%
	C3	949	3.61%
	C1	701	2.67%
	C4	400	1.52%
	Total	26,278	100%

**Table 5.** Statistical table of mother-child interaction behavior.

Behavior name		Number of Behaviors	Behavior Ratio
Mother's conversational behavior	Directive utterances	11,572	44.03%
	Language-modelling utterances	5610	21.35%
	Total	17,182	65.08%
Children's conversational behavior	There are words	6312	24.02%
	No Words	2784	10.59%
	Total	9096	34.61%

child dialogue during communication or the difficulty of mothers in guiding children's speech. Second, the ratio of mothers' directive utterances to language-modeling utterances was about 2.06:1, showing us that most of the mothers of children with ASD talk with a tendency to control the child with ASD while providing less language-modeling utterances.

### 3.2. LSA of Mother-Child Verbal Interaction

A total of 26,237 mother-child verbal interaction behavior sequence relationships emerged during the conversation between mother and child with ASD, and the distribution is shown in **Table 6**. Each column indicates the beginning behavior that emerged, and each row indicates the behavior that occurred subsequently. The numbers indicate the frequency of the following behavior occurring after starting one. The table contents were converted to standard scores to obtain the residual table in **Table 7**. According to the theory of LSA, if the Z-score value  $> 1.96$ , the behavior sequence reaches the level of significance ( $p < 0.05$ ).

Behavior sequences with Z-score values  $> 1.96$  were filtered according to the residual table, and behavior transitions were plotted. The boxes in the figure indicate various mother-child speech acts, the connecting lines indicate that the transition between acts is significant, the arrows represent the direction of the behavior transition, and the data on the lines are the adjusted residual values (Z-score). To more clearly demonstrate the effects of maternal conversational behavior on children's conversational behavior, we plotted two patterns of behavioral sequences separately, according to the mother's utterances.

#### 3.2.1. LSA of Directive Utterances

Pattern A is a pattern of verbal interaction based on the mother's directive utterances. The following findings were made regarding this part of the sequence (See **Figure 1**).

First, the M4 (questions)-C2 (answers)-M4 (questions), M4 (questions)-C5 (non-answer)-M4 (questions), and M4 (questions)-C6 (idiosyncratic conversation)—The highly significant relationship and one or even multiple cycles between the three sequences of M4 (questions) suggested that the mother's constant questioning and the switching of conversational rounds may have been

**Table 6.** Frequency conversion table of mother-child verbal behavior.

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	C1	C2	C3	C4	C5	C6	Total
M1	63	6	54	66	0	6	2	2	35	3	15	31	1	0	26	15	325
M2	7	109	153	93	4	16	1	0	94	7	26	30	26	9	6	26	607
M3	64	101	1701	724	9	70	52	8	561	144	189	447	150	43	72	162	4497
M4	18	12	95	180	4	13	3	1	68	11	70	2051	34	67	2442	480	5549
M5	0	9	19	49	11	6	1	0	27	10	14	118	4	74	180	59	581
M6	4	6	67	110	3	71	3	0	75	6	6	46	18	5	0	20	440
M7	9	14	170	279	16	9	18	16	105	58	37	40	56	10	21	24	882
M8	1	4	25	66	1	0	2	9	26	11	10	22	20	3	0	4	204
M9	38	72	595	698	5	50	34	5	860	69	142	227	151	39	29	112	3126
M10	8	16	190	225	4	10	28	8	121	101	53	37	49	7	0	17	874
C1	6	16	116	126	58	19	76	9	81	26	32	4	100	19	1	11	700
C2	14	90	443	889	226	41	411	97	353	241	42	63	117	70	1	31	3129
C3	4	35	130	156	44	7	118	18	120	81	23	5	180	9	1	17	948
C4	1	11	52	89	40	6	45	10	51	30	8	2	17	30	0	7	399
C5	66	65	519	1462	71	91	31	9	412	29	7	5	3	1	2	6	2779
C6	21	43	165	323	86	25	57	13	143	47	19	4	23	14	3	139	1125
Total	324	609	4494	5535	582	440	882	205	3132	874	693	3132	949	400	2784	1130	26,165

**Table 7.** Table of residuals of frequency of mother-child verbal behavior.

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	C1	C2	C3	C4	C5	C6
M1	29.77*	-0.58	-0.27	-0.38	-2.74	0.23	-2.77	-0.35	-0.67	-2.44	2.22*	-1.36	-3.22	-2.26	-1.55	0.26
M2	-0.19	25.84*	5.31*	-3.56	-2.65	1.85	-4.43	-2.22	2.7*	-3.03	2.54*	-5.4	0.88	-0.09	-7.8	-0.04
M3	1.23	-0.4	40.34*	-9.12	-10.11	-0.72	-9.04	-5.06	1.15	-0.57	7.13*	-4.61	-1.15	-3.44	-21.6	-2.6
M4	-6.94	-11.75	-34.41	-36.8	-12.25	-9.45	-15.42	-7.29	-27.78	-14.67	-7.25	64.61*	-13.53	-2.2	90.81*	17.88*
M5	-2.73	-1.26	-8.99	-7.59	-0.55	-1.23	-4.32	-2.17	-5.5	-2.2	-0.36	6.26*	-3.83	22.27*	16.08*	7*
M6	-0.63	-1.35	-1.09	1.99	-2.21	23.78*	-3.15	-1.88	3.31*	-2.33	-1.69	-0.99	0.52	-0.68	-7.3	0.24
M7	-0.6	-1.48	1.68	7.75	-0.84	-1.55	-2.23	3.53*	-0.06	5.44*	2.91*	-6.92	4.4*	-0.97	-8.09	-2.37
M8	-0.97	-0.35	-1.87	3.93	-1.69	-1.88	-1.9	5.9*	0.34	1.64	2.01*	-0.52	4.74*	-0.07	-4.95	-1.66
M9	-0.12	-0.1	2.94*	1.71	-8.34	-0.38	-7.54	-4.21	28.53	-3.76	7.03*	-8.64	3.84*	-1.37	-18.77	-2.16
M10	-0.88	-0.99	3.64*	3.38*	-3.6	-1.26	-0.28	0.45	1.74	13.75*	6.4*	-7.17	3.18*	-1.78	-10.38	-3.51
C1	-0.92	-0.07	-0.43	-2.07	11.02*	2.15*	11.12*	1.53	-0.33	0.56	3.21*	-9.42	15.29*	2.59*	-9.13	-3.62
C2	-4.26	2.17*	-4.77	10.59*	20.21*	-1.72	32.25*	15.66	-1.26	14.47*	-4.85	-18.29	0.36	3.44*	-20.51	-9.76
C3	-2.32	2.84*	-2.88	-3.61	5.14*	-2.3	15.77*	3.97	0.66	9.08*	-0.43	-11.06	25.77*	-1.48	-10.72	-3.9

## Continued

C4	-1.8	0.57	-2.21	0.57	10.65*	-0.28	8.82*	3.93	0.5	4.68*	-0.81	-7.11	0.68	9.83*	-6.95	-2.54
C5	5.73*	0.04	2.22*	42.95*	1.25	6.91*	-6.97	-2.91	4.9*	-7.13	-8.32	-20.25	-10.5	-6.78	-19.11	-11.25
C6	1.95	3.4*	-2.28	6.34*	12.6*	1.44	3.22*	1.45	0.78	1.6	-2.05	-12.27	-2.9	-0.79	-11.53	13.56*

\* $p < 0.05$ .

effective. However, the utterances initiative was in the mother's hands.

Second, the sequences C5 (non-answer)-M1 (lead attentional directives)-C1 (invitation), C5 (non-answer)-M3 (follow-in directives)-C1 (invitation) showed that when the child non-answer, if the mother tried to attract the child's attention by lead attentional directives to attract the child's attention or follow-in directives to the activity the child is doing, the child may start a new topic based on the scene at hand.

Again, the sequences C2 (answers)-M2 (verbal prohibitions or reprimands)-C1 (invitation), C3 (expands)-M2 (verbal prohibitions or reprimands)-C1 (invitation) showed that the mother's verbal prohibitions or reprimands of the child's appropriate behavior lead the child switch topics.

Finally, the sequences C1 (invitation)-M5 (request for clarification) and C3 (expands)-M5 (request for clarification) showed that if the mother's request for clarification followed the child's speech, there were repairs, non-answers, idiosyncratic conversations or answers. These results suggested that children's responses to their mothers' requests for clarification are diverse. It suggested that mother's requests for clarification may require specific strategies to be taught to receive repairs or answers from the child (Figure 1).

### 3.2.2. LSA of Language-Modelling Utterances

Model B is a model of interaction based on the mother's language-modeling utterances, and the following findings are specific to this part of the sequence (See Figure 2).

Overall, it can be found that in addition to M6 (labels), M7 (imitation), M8 (recasts), M9 (descriptions or comments), and M10 (affirmation or support) of the mother may elicit C1 (Invitation) and C3 (expands) of the child.

First, in the language-modeling utterances, no mother behaviors caused children to have idiosyncratic conversations. The sequences C6 (Idiosyncratic conversation)-M7 (Imitation)-C1 (Invitation) and C6 (Idiosyncratic conversation)-M7 (Imitation)-C3 (expands) suggested that maternal repetition has an ameliorative effect on children's idiosyncratic conversations.

Second, the mother's labeling behavior did not impact the child, but the child may also benefit from the mother's labeling. It just did not manifest itself through immediate behavior.

Third, the sequences C5 (Non-answer)-M9 (Description or comments)-C3 (expands), C5 (Non-answer)-M9 (Descriptions or comments)-C1 (Invitation) suggested that description or comment by the mother when the child does not res-



pond led to the continuation of the conversation or shift to a new topic.

Fourth, the sequences M10 (Affirmation or support)-C3 (Expansion) and M10 (Affirmation or support)-C1 (Invitation) suggested that the effect of maternal affirmation or support on children with ASD is uncertain.

Finally, regarding the sequence M8 (recast)-C3 (expands) and the sequence M8 (recasts)-C1 (Invitation), we can see one or more cycles between M8 and C3, suggesting a more significant role of maternal recasting in the expansion of the child.

## 4. Discussion

The results of this study demonstrate a new measure of mother-child interaction by showing the differences in the behavior of children with ASD between the two modes of mothers' use of directive utterances and language-modeling utterances. In addition, this study also used behavioral frequency analysis to demonstrate the frequency of use of directive utterances and language-modeling utterances by mothers and the child's conversational behaviors. The following discussion was conducted from two dimensions: directive utterances and language-modeling utterances.

### 4.1. Discussion of Directive Utterances

Through behavioral frequency statistics, we found that the ratio of mothers' directive utterances to language-modeling utterances was 2.06:1. Moreover, lead attentional directives (4505, 21.12%) were the most frequent of all behaviors among the directive utterances, about which two reasons can be explained. First, the strategies used by any parent in interacting with their child may depend on socioeconomic status and cultural norms (Gogate, Bahrick, & Watson, 2000; O'Neil-Pirozzi, 2006). This is unconsciously reminiscent of the cultural influences on mothers in China. According to reports, Chinese mothers use more instructional language (or utterances with instructional intent) with their children than American mothers (Kita, 2009). Jose et al.'s (2000) study showed that Chinese parents in America use more instructions when interacting with their children compared to European mothers in America. Second, according to Gillum, Nelson and Camarata (2003) mothers of children with ASD behave more directly during interactions than mothers of regular children, which was not included in this study, so there is no way to compare, but directive utterances did occur more often than demonstrative utterances. This may be because children with ASD face significant challenges in engaging in interactions and maintaining conversations. One study reported that children with ASD do not have frequent eye contact, turn-of-talk skills, and referential eye contact from a very young age (Wimpory et al., 2000). This is consistent with Krupa et al. (2019), i.e., parents constantly give instructions or commands to their children because they assume that such sessions will produce more joint participation and attention in their children.

Questions have been considered a strategy to encourage children to talk or

elicit their language (Howlin et al., 1973), but sometimes it may not be as effective as they should be. In the present study, the questions (3395, 17.14%) behavior occurred second in frequency. It cycled once or even more in the behavioral sequence with the behavioral sequence of non-answer ( $z = 90.81, p < 0.05$ ), idiosyncratic conversation ( $z = 17.88, p < 0.05$ ). Such behavioral sequences suggest that children with ASD feel great pressure when their mothers constantly ask questions but fail to give timely verbal support, at which point they tend to fulfill their session obligations with idiosyncratic conversation or non-answer.

When mothers use requests for clarification behaviors, children are asked to repair failures in conversation. According to previous research, the ASD group can respond to such communication failures; they employ various techniques to respond to conversational failures and add more information as the failures persist while producing more inappropriate language (Volden, 2004). In the present study, it was found that when the mother asked for clarification, the children showed a non-answer ( $z = 16.08, p < 0.05$ ), answers ( $z = 6.26, p < 0.05$ ), an idiosyncratic conversation ( $z = 7, p < 0.05$ ), repairs ( $z = 22.27, p < 0.05$ ), and one or even multiple cycles between them. This is consistent with Volden's (2004) study. More specific results were obtained in the current study. The behavioral sequences showed that child's responses to their mothers' Requests for clarification were diverse, suggesting that mothers should increase their sensitivity to capture children's conversations in time during the sessions.

Finally, the sequences in this study suggest that children's responses to maternal verbal prohibitions or condemnations and lead attentional directives are Invitations. Maternal verbal prohibitions or condemnations can protect children from harm (e.g., "Don't go there"), manage behavior (e.g., "Don't throw toys"), or instill good play behavior in children (e.g., "Don't hit"). In contrast, the directing attention command is designed to distract or engage the attention of the child with ASD, and the mother may go on to call their name more frequently. In addition, it serves a similar but different purpose than the follow-in directives. It is possible that the mother's purpose of lead attentional directives is to guide the behavior rather than elicit a response from the child and therefore does not contribute as much to the child's conversational development. According to previous studies, follow-up instructions (follow-in directives) are associated with better language outcomes in children with ASD (McDuffie & Yoder, 2010), so we argue that in addition to guiding behavior, mothers' lead attentional directives may facilitate the mapping between labels and objects or events in a similar way to follow-up comments (Mccathren, Yoder, & Warren, 1995; McDuffie & Yoder, 2010), just not manifested through immediate behaviors.

## 4.2. Discussion of Language-Modeling Utterances

By counting the frequency of behaviors of language-modeling utterances, we found that mothers used more descriptions or comments (3135, 11.93%) compared to labels (440, 1.67%), imitation (882, 3.36%), recasts (205, 0.87%), and affirmation or support (948, 3.61%) among all behaviors classified as language-modeling

utterances. This suggests that using descriptions or comments may be a more naturally occurring interactive behavior for mothers of children with ASD than other language-modeling utterances. Therefore, when implementing a parent-centered intervention program, therapists should encourage parents to engage in more language-modeling utterances based on descriptions or comments. The following explains the sequence that unfolds around the mother's language-modeling utterances.

First, suppose mothers describe children's non-answer behavior (non-answer—descriptions or comments—expands or invitation). In that case, maternal descriptions or comments are thought to provide children with essential connections between words and objects in their environment, thus facilitating language learning in a responsive manner (Girolametto & Weitzman, 2002). In other words, descriptions or comments provide children with opportunities for verbal input, which also gives children the initiative to take control of the conversation. Another explanation, in conjunction with the findings of this study, is that if children are attentive and interested in the topic, it is likely that children will expand on the mother's topic if the mother describes the current event. For example,

\*M: Let the rabbit lean against the window, and then it can look outside the view.

\*C: You can see the view outside.

In contrast, when children's attention is shifted, they may ignore the mother's descriptions or even initiate new topics, leaving the mother baffled. For example,

\*M: The little monkey is so poorly pinned down.

\*C: The man.

\*M: Who?

Second, if the mother can imitate the child's idiosyncratic conversation (idiosyncratic conversation—imitation—expands or invitation), this may give the child the option to continue to expand the topic or invite a new one. Following Sokolov's (1993) suggestion, imitation or partial imitation lets children know that they are interested in their activity and is considered to provide them with "linguistically relevant information." In this way, children actively express themselves without limiting their responses, so they are free to invite or expand the topic of their choice.

Again, given that mothers' labels during interactions are thought to facilitate language learning because children make connections between words and objects when mothers provide markers (Girolametto & Weitzman, 2002). However, the results of this study are puzzling in that maternal labeling did not affect children's behavior. We speculate that perhaps the mothers used this opportunity as a teaching activity and did not care if the children responded. However, the labels may still have provided helpful information to the children and even reinforced existing knowledge about them.

Finally, affirmation or support creates a warm environment for children to have conversations. For example,

\*C: Get on the six-zero-two bus (C says while drawing the light).

\*M: Good.

\*C: This one has a door.

\*M: Good.

When the child was drawing, the mother affirmed or supported his behavior, the child described his own drawing, the mother gave affirmation or support, and the child initiated a new topic. For example,

\*M: You want to draw a bus, don't you?

\*C: Yes.

\*M: Okay (M looks at C in the drawing and says).

\*C: Door.

It is evident that the mother's affirmation or support initiates the child into new topics, which can sometimes be a good thing; the mother's affirmation or support lets the child with ASD know that they are on the right path, thus increasing their motivation and interest in generating more language.

### 4.3. Limitations and Future Directions

The current study uses LSA to support a causal explanation of mother-child with ASD interactions. There were far more boys than girls in the current study. While this reflects the reality that more boys than girls are diagnosed with ASD, efforts should also be made to involve more girls with ASD if it is hoped that future research will benefit a larger group. In addition, this study focused on recording verbal communication behaviors during mother-child interactions. However, nonverbal communication skills, including gestures, are also an essential part of mother-child with ASD interactions (Manwaring et al., 2017). Therefore, future studies need to examine the relationship between other verbal and nonverbal behaviors and children's communication skills. By doing so, we could understand how children with ASD benefit from interventions designed to increase the frequency and types of gestures.

### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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