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The influence of maternal language responsiveness on the expressive speech production of children with autism spectrum disorders: A microanalysis of mother–child play interactions

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Abstract
Adult responsiveness is related to language development both in young typically developing children and in children with autism spectrum disorders, such that parents who use more responsive language with their children have children who develop better language skills over time. This study used a micro-analytic technique to examine how two facets of maternal utterances, relationship to child focus of attention and degree of demandingness, influenced the immediate use of appropriate expressive language of preschool-aged children with autism spectrum disorders (n = 28) and toddlers with typical development (n = 16) within a naturalistic mother–child play session. Mothers' use of follow-in demanding language was most likely to elicit appropriate expressive speech in both children with autism spectrum disorders and children with typical development. For children with autism spectrum disorders, but not children with typical development, mothers' use of orienting cues conferred an additional benefit for expressive speech production. These findings are consistent with the naturalistic behavioral intervention philosophy and suggest that following a child's lead while prompting for language is likely to elicit speech production in children with autism spectrum disorders and children with typical development. Furthermore, using orienting cues may help children with autism spectrum disorders to verbally respond.

Keywords
autism spectrum disorders, responsiveness, speech

Introduction

Autism spectrum disorders (ASD) are developmental disorders characterized by impairments in social-communication skills and the presence of repetitive or stereotyped interests (American Psychiatric Association (APA), 2013). Children with ASD usually demonstrate impairment in a variety of early-emerging social-communication skills, including language and joint attention (e.g. Tager-Flusberg, 2000). The ability to follow another person's attention, known as responding to joint attention (RJA), is well established in typically developing children by 18–21 months of age (Mundy and Gomes, 1998). However, children with ASD are usually impaired in their RJA abilities (e.g. Mundy et al., 1990) and these deficits may persist into middle childhood for many children with ASD (Leekam et al., 1998). Correlational studies have suggested that RJA skills predict later language skills in young typically developing children (e.g. Morales et al., 2000) as well as children with ASD (e.g. Anderson et al., 2007; Sigman and Ruskin, 1999; Siller and Sigman, 2002), suggesting that RJA deficits may play a role in language learning difficulties for children with ASD.

Naturalistic studies of parent–child interactions in ASD have indicated that parents who follow their child's lead during play have children who develop better social-communication skills over time. Siller and Sigman (2002,

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2008) found that parents who used more follow-in language with their children with ASD had children with more positive language outcomes up to 16 years later. In particular, they found that "caregiver contingent comments," or language that followed the child's focus of interest without making a demand, were related to positive language outcomes. McDuffie and Yoder (2010) also found that parents' use of follow-in language (both demanding and non-demanding) was positively related to vocabulary growth in children with ASD over the course of 6 months. A recent study that separated parents' use of follow-in directives for language from follow-in directives for behavior found that language directives, but not behavior directives, promoted children's language growth over a period of 1 year (Haebig et al., 2013). Parent training programs focused on promoting responsiveness have also indicated that parent responsiveness may have a causal influence on language development in children with ASD (e.g. Aldred et al., 2004; Coolican et al., 2010; Green et al., 2010; Kaiser et al., 2000; McConachie et al., 2005; Siller et al., 2013). However, different interventions have targeted different elements of responsiveness, including use of both demanding and non-demanding language, with beneficial effects found across a number of treatment models. Taken together, these findings suggest that language that follows a child's interest is beneficial for language development in children with ASD; however, different studies have reached different conclusions about whether non-demanding or demanding language may be more beneficial.

This body of research suggests that responsive language may be particularly beneficial for children with ASD, in part because these children have difficulty joining an adult's focus of attention. However, it is clear that in everyday situations adults are not able to follow children's attention at all times. This may be particularly true for children with ASD, who may be frequently unengaged with meaningful activities and may provide few high-quality attentional leads for parents to follow. In addition, even when adults follow-in to the attentional focus of a child with ASD, the child may nevertheless have difficulty including their interaction partner in this exchange (e.g. Lewy and Dawson, 1992). Given that children with ASD tend to be poor at following others' attention, it is likely that parents and other adults frequently use orienting cues (e.g. saying "look" or the child's name, touching the child, withholding a desired item) to help children with ASD attend to important stimuli in their environment. However, the types of orienting cues that mothers use to support their children's attention, and how children respond to these cues, have rarely been examined in detail. There is some evidence that researchers' use of redundant orienting cues such as pointing to accompany gaze cues may increase the ability of children at-risk for ASD to follow an adult's focus of attention (Presmanes et al., 2007), and Siller and Sigman (2002) found that mothers' use of synchronized indicating behaviors (handing the child a toy he is interested in and pointing to a toy the child is playing with) was associated with gains in initiating joint attention over time. In addition, Walton and Ingersoll (2013) found that using a verbal orienting cue (i.e. saying "look" or the child's name) while teaching new vocabulary words to children with ASD increased children's likelihood of learning the word, as compared to a condition in which the adult used only a gaze cue to direct the child's attention to the object. However, these studies have not examined whether the use of orienting cues helps children with ASD to verbally respond to their parents' redirections within the immediate play context. Therefore, examining which maternal behaviors may support children's use of language during mother–child interactions may be helpful when considering how parents and caregivers can best support their child's language acquisition.

While the longitudinal correlational designs and experimental designs described in previous studies have the benefit of tracking children's skill growth over a period of time, longitudinal correlational designs make it difficult to draw conclusions about causality. With these correlational designs, a number of alternative explanations for the relationship between maternal and child language are possible. For example, mothers and their children may have shared genetic factors related to language or social behaviors. Alternatively, children's behaviors at time one could influence both maternal language patterns and the children's future language outcomes. In addition, many of the experimental studies have combined several potentially important parent behaviors into intervention packages, making it difficult to determine which specific parent behaviors lead to improvements in the skills of children with ASD. Conducting microanalyses of adult–child interactions is one technique that can add complementary information to these longitudinal designs by yielding data about the types of adult behaviors that are likely to immediately elicit specific social-communication behaviors in children with ASD. Wimpory et al. (2007) conducted microanalyses of videotaped adult–child interactions to examine what types of adult behaviors were likely to elicit episodes of social engagement in children with ASD. They found that certain adult behaviors, such as musical/motoric activity, communications that followed the child's focus of attention, scaffolding through social routines, imitations of the child, and adult repetitions, were more likely to precede child episodes of social engagement. Some of the adult behaviors found to precede children's episodes of social engagement in Wimpory et al.'s (2007) study are similar to the types of adult behaviors that have been associated with gains in children's social-communication skills over time. For example, Wimpory et al. (2007) found that adults' use of communications that followed the child's focus of attention were likely to precede episodes of social engagement during adult–child interactions. Similarly, Siller and Sigman (2002) found that mothers' use of "contingent comments" that followed the child's focus of attention was related to positive language outcomes, and that mothers' use of synchronized indicating behaviors (handing the child a toy he is interested in and pointing to a toy the child is playing with) was associated with gains in initiating joint attention over time. This similarity in findings suggests that identifying adult behaviors that elicit certain child behaviors within a single parent–child interaction may provide useful insight into the types of behaviors that may also promote child skill growth over time.

Study goals

While several previous studies have examined how parents' language behavior is related to language growth *over time* in children with ASD, no study to date has used microanalysis to examine what types of parent language are most likely to elicit child speech *within a single conversational turn*. This study aimed to examine how two facets of maternal utterances, relationship to child focus of attention (follow-in versus not follow-in) and demandingness (demanding versus non-demanding), influenced the immediate use of appropriate expressive language of children with ASD and children with typical development within a naturalistic mother–child play session. Furthermore, maternal demanding utterances were broken down into a number of potentially meaningful categories, including play directions and language prompts, to determine whether one particular type of demanding utterance was more beneficial than another. Additional orienting cues (e.g. calling the child's name, touching the child, and blocking the child's play) used by mothers in conjunction with their language were also examined to determine whether the use of these cues had an impact on child utterances. This fine-grained analysis of parent and child speech will add to the existing longitudinal and treatment literature by clarifying whether the types of maternal utterances that appear to promote language gains in children with ASD over time are the same as the types of maternal utterances that promote child utterances within the immediate conversational context.

Methods

Participants

Participants were 28 children with ASD (24 males, 4 females) and 16 children with typical development (9 males, 7 females) and their mothers. Participants with ASD were selected from a pool of 47 children with ASD (41 males, 6 females) between the ages of 25 and 93 months and their mothers who were recruited from local agencies and professionals serving young children with ASD. All children with ASD met the cut-off for autism or autism spectrum on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000). Of these, 19 children with ASD were excluded from analyses because of technical difficulties with sound on the video recordings (4), because the child did not use any appropriate language during the 10-min interaction (11), because the parent spoke a language other than English during the video (1), because both parents participated in the parent–child interaction simultaneously (1), or because two children in the same family participated (2); in these cases, the child who used more language during the video was retained in the sample and the other child was excluded.

Participants with typical development were 16 children with typical development (9 males, 8 females) between the ages of 16 and 29 months and their mothers. Participants were recruited such that the chronological ages of the participants with typical development approximately matched the expressive language level (based upon the Preschool Language Scale, 4th Edition (PLS-4)) of the children with ASD. Potential participants were drawn from a pool of families who expressed interest in participating in child development research during recruitment fairs in community locations likely to attract families. Children were excluded from participation if parents reported a history of developmental difficulties, including language delays, or if the child had an immediate family member (parent, sibling) with an ASD. All children were screened for developmental concerns using the Communication and Symbolic Behavior Scales–Developmental Profile Infant-Toddler Checklist (CSBS-DP; Wetherby and Prizant, 2002) and scored in the "No Concern" range in all areas. One mother–child dyad in the typically developing group was excluded from analyses because the child did not use any appropriate language during the 10-min interaction. The two samples did not differ significantly in nonverbal mental age. However, the typically developing group scored higher than the children with ASD on measures of language, vocabulary, and joint attention skills. Characteristics of the participants included in the final sample are reported in Table 1.

Assessment procedure

Each child participated in a 10-min videotaped semi-structured play session with his or her mother. Each mother–child dyad was provided with a standard set of age-appropriate toys, including a baby doll, a kitchen set, a car ramp, blocks, and a musical ring-stacking toy. Mothers were asked to play with their children as they usually would. They were instructed to focus on helping their children to demonstrate their language/communication skills during the first 5 min of the interaction, and helping their children to use their play skills (all typically developing children and 22 children with ASD) or their social engagement skills (6 children with ASD) during the second 5 min

Table 1. Participant characteristics.

	ASD			Typical			Group comparisons		
	N	Mean	Range (*SD*)	N	Mean	Range (*SD*)	*p*	Cohen's d	Variance ratio
Age (months)	28	48.29*	31–93 (13.06)	16	24.13	16–30 (4.31)	< .001	2.25	9.18
Cognitive age equivalent (Bayley)	26	26.62	11–41 (6.61)	16	26.13	16–33 (4.44)	.795	0.08	2.21
Auditory comprehension age equivalent (PLS-4)	28	22.96*	8–46 (9.04)	16	32.06	22–50 (8.27)	.002	−1.04	1.19
Expressive language age equivalent (PLS-4)	28	24.82*	12–40 (5.67)	16	31.63	22–46 (6.70)	.001	−1.12	0.72
Total language age equivalent (PLS-4)	28	23.36*	10–41 (6.75)	16	31.19	21–48 (7.40)	.001	−1.12	0.83
Number of words produced (CDI)	27	219.81*	0–628 (188.41)	16	358.06	36–671 (197.34)	.028	−0.72	0.91
Number of joint attention initiations (ESCS)	28	3.82*	0–17 (4.65)	15	13.00	2–41 (10.25)	< .001	−1.30	0.20
Percentage responses to joint attention (ESCS)	28	66.50*	0–100 (27.25)	15	97.93	77–100 (6.15)	< .001	−1.40	19.63

ASD: Autism spectrum disorder; *SD*: standard deviation; PLS-4: Preschool Language Scale, 4th Edition; CDI: Communicative Development Inventory; ESCS: Early Social-Communication Scales.
* Significantly different from typical group, $p < .05$.

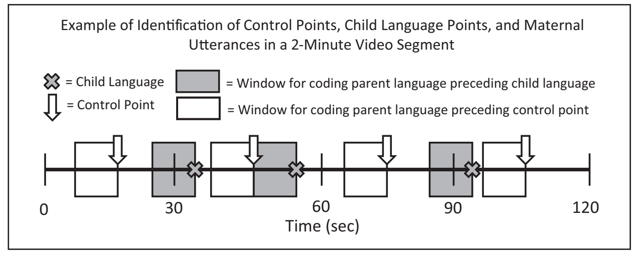

Figure 1. Child language points identified throughout video. Control points identified at regular 30-s intervals. Following identification of child language and control points, the maternal utterance most immediately preceding each point was identified, going back up to 10 s to identify an utterance.

of the interaction.[1] Children were also administered the PLS-4 (Zimmerman et al., 2002) to measure language skills, the Bayley Scales of Infant Development, 3rd Edition (Bayley, 2005), Cognitive Scale to measure nonverbal cognitive skills, and the Early Social-Communication Scales (Seibert et al., 1982) to measure joint attention skills. Mothers were asked to complete the MacArthur-Bates Communicative Development Inventory (Fenson et al., 1994) to measure expressive vocabulary size.

Videotape analysis

Each videotaped mother–child interaction was coded using a micro-analytic technique to identify what type(s) of maternal utterances preceded child expressive language use during the session. Child utterances and control points were identified throughout the video, and the maternal utterance that most immediately preceded the child utterance or control point was identified and categorized on a number of facets. If a particular maternal utterance type was more likely to precede child utterances than control points, this type of maternal utterance was interpreted as eliciting child utterances. If a particular maternal utterance type was more likely to precede control points than child utterances, this type of maternal utterance was interpreted as discouraging child utterances. See Wimpory et al. (2007) for a more detailed description of analysis procedures. See Figure 1 for a visual representation of coding procedures.

Identifying child utterances. The 10-min videotaped play sessions were coded by trained undergraduate and graduate research assistants in two passes. Each videotape was first coded to identify appropriate verbal utterances made by the child (child utterances). An appropriate verbal utterance was defined as one or more recognizable words that were appropriate to the current situation or conversation. Instances of immediate or delayed verbal echoing that were appropriate responses to a maternal utterance (e.g. mother says, "Do you want the baby?" and child responds "Baby" or "Want the baby") or appropriate to the play context (e.g. counting by rote while stacking blocks) were coded as appropriate language the first time. If the child repeated the same word or phrase within a 10-s period, or if the echoed portion of the response was not appropriate to context (e.g. mother says, "What do you want?" and child responds, "What do you want?"), it was not scored as appropriate language.

Identifying control points. An additional 20 points were identified at 30-s intervals throughout the 10-min videotape (regardless of whether a child utterance occurred at this time), with the first interval at 15 s into the video, the second at 45 s, and so forth every 30 s throughout the video (control points). Control points were used to calculate base rates of different types of maternal utterances for each individual mother.

Identifying maternal utterances. After child utterances and control points were identified throughout the 10-min video, a second coder used this log of child utterances and control points to identify and categorize maternal utterances preceding these points. In order to identify each maternal utterance, the coder moved backwards in the videotape from each child utterance or control point to identify the maternal utterance that occurred immediately preceding the identified point in the video. For maternal utterances preceding child utterances, the maternal utterance that occurred closest in time to the child utterance was used, going back to the preceding child utterance or up to 10 s (whichever duration was shorter) to identify a maternal utterance. For maternal utterances preceding control points, the maternal utterance that occurred closest in time to the control point was used, going back up to 10 s (and disregarding any child utterances that might occur during that 10 s interval). Therefore, it is possible that the same maternal utterance could be identified as preceding both a child utterance and a control point, if the child utterance and control point occurred close together in time. If the mother did not make any verbal utterance in the 10 s preceding the child utterance or control point, this point was coded as "no actions" and excluded from further analyses.

Categorizing maternal utterances. After maternal utterances were identified, the coder then categorized each maternal utterance on two independent facets: relationship to child focus of attention (follow-in versus not follow-in) and degree of demandingess (demanding vs non-demanding). This coding procedure produced four broad categories of parent language: follow-in demanding, follow-in non-demanding, not follow-in demanding, and not follow-in non-demanding. The coder also identified each demanding utterance by type of demand (verbal prompt, play prompt, or other prompt). Finally, the coder identified each utterance by whether or not it was accompanied by an orienting cue. See Figure 2 for detailed scoring definitions and examples.

Reliability

A total of 32% of mother–child interaction videotapes were coded for child utterances and maternal utterances by a second observer to check reliability. Exact agreement for identifying a child utterance was calculated by dividing the total number of agreements by the sum of agreements and disagreements. Average exact agreement for child utterances was 81% across the subset of videos analyzed for reliability. Cohen's kappa was .61 for relationship to child focus of attention, .71 for degree of demandingness, .67 for use of orienting cues, .73 for language prompts, .62 for play prompts, and .66 for other behavior prompts. These kappa values are considered "good" (Landis and Koch, 1977).

Data transformation

Prior to data transformation, child utterances and control points, as well as the types of maternal utterances that preceded each point, were identified individually for each child (as described above). Data were then analyzed on the level of the dyad. To accomplish this, data collected about maternal utterance type were tallied separately for each child and the following data transformation was conducted individually for each dyad. First, the number of maternal utterances of each type that preceded child utterances was divided by the total number of child utterances for that dyad and multiplied by 100 (to create a percentage). This calculation resulted in a percentage indicating the relative frequency of each type of maternal utterance occurring immediately prior to a child utterance (*rate preceding child utterance)*. Second, the number of maternal utterances of each type that preceded control points was divided by the total number of control points for that dyad and multiplied by 100 (to create a percentage). This calculation resulted in a *base rate* of relative frequency of use of each type of maternal utterance (for each individual mother). When conducting these data transformations for the subcategories of orienting cue versus no orienting cue used, percentages for follow-in and redirecting points were calculated separately. For example, when calculating the subcategory of follow-in maternal utterances with no orienting cues, the number of *follow-in* child utterances and *follow-in* control points for each dyad were used as the denominators, rather than the *overall* number of child and control points for that dyad.

For some analyses, difference scores between the *rate preceding child utterance* and the *base rate* of each type of maternal utterance were used. For these analyses, difference scores for each maternal utterance type were calculated individually for each dyad. This was accomplished

		Follow-In		Not Follow-In	
		Definition	Examples	Definition	Examples
Demanding	Verbal Prompt	Makes a **demand** on the child to say a word or phrase that is *related to his current focus of interest*	"Say bear" while the child is holding a teddy bear. "Tell me what color this ball is" while the child is looking at a ball.	Makes a **demand** on the child to say a word or phrase that is *unrelated to his current focus of interest*	"Say bear" while the child is playing with blocks. "Tell me what color this ball is" while child is trying to play peek-a-boo.
	Play Prompt	Makes a **demand** on the child to perform a play action that is *related to his current focus of interest*	"Put the man in the bus" while the child is pushing the bus. "Throw the ball to me" while the child is holding a ball.	Makes a **demand** on the child to perform a play action that is *unrelated to his current focus of interest*	"Put the man in the bus" while the child is playing with blocks. "Throw the ball to me" while the child is playing with a baby doll.
	Other Prompt	Makes a **demand** on the child to perform a behavior (not play or language) that is *related to his current focus of interest*	"Don't do that" when the child tries to stand on the couch.	Makes a **demand** on the child to perform a behavior (not play or language) that is *unrelated to his current focus of interest*	"Come sit over here" while the child is playing blocks across the room from the parent.
Non-Demanding		Makes a **comment** to the child that **does not imply or require a response** and that is *related to the child's current focus of interest*	"You have a baby doll" while the child is playing with a doll. "Vroom! Vroom!" while the child is pushing a car.	Makes a **comment** to the child that **does not imply or require a response** and that is *unrelated to the child's current focus of interest*	"I have a baby doll" while the child is playing with blocks. "Vroom! Vroom!" while the parent pushes a car and the child builds with blocks.

Orienting Cues

1. Saying the child's name
2. Saying "look" or another attention-getting word
3. Withholding a toy from the child.
4. Blocking the child's play
5. Touching the child

Figure 2. Each maternal utterance was coded on two different facets: follow-in versus not follow-in, and demanding versus non-demanding. Demanding utterances were further categorized by prompt type (language, play and other). Each utterance was also coded for whether or not it was accompanied by an orienting cue.

by subtracting the *base rate* of each maternal utterance type from the *rate preceding child utterances* for that maternal utterance type to create a difference score for each maternal utterance type for each dyad. Conducting analyses using difference scores (that took into account base rates) was important in order to account for instances in which a particular type of maternal utterance might occur frequently prior to child utterances simply due to the mother frequently using that type of utterance. For example, if 75% of maternal utterances preceding child utterances were follow-in demanding, this might initially appear to indicate that (for this dyad) follow-in demanding maternal utterances encourage child utterances. If that mother's base rate of follow-in demanding utterances was only 30%, this remains a reasonable interpretation. However, if that mother's base rate of follow-in demanding utterances was 75% (the same as the rate preceding child utterances), a more reasonable interpretation would be that maternal follow-in demanding utterances tended to precede child utterances for this dyad simply because the mother used this type of utterance very frequently. By using difference scores in analyses, we were able to account for differences in mothers' individual base rates of each utterance type by comparing the rate of a particular utterance type that preceded child utterances to the base rate of this utterance type for each mother.

Results

Preliminary analyses

Because the typically developing group had a higher mean expressive language age equivalent on the PLS-4 than the ASD group and these scores were significantly ($p < .05$) correlated with several other potentially important child skills (initiating joint attention $r = .343$, RJA $r = .577$, Bayley Age Equivalent $r = .524$) as well as with several outcome variables (Difference Score for Follow-In Language Prompts $r = -.544$, Difference Score for Follow-In Other Behavior Prompts $r = .328$, Difference Score for Non-Demanding Redirecting Maternal Utterances $r = .387$), PLS-4 expressive language age equivalents were used as a covariate in all analyses. PLS-4 scores were centered to account for the fact that the mean PLS score was significantly greater than zero (Van Breukelen and Van Dijk, 2007). All analyses were conducted using SPSS Statistics Version 21.

Child utterances. The total number of child utterances during the 10-min play interaction ranged from 2 to 74 (M = 25.5, standard deviation (SD) = 18.3) for children with ASD and from 5 to 89 (M = 51.3, SD = 27.6) for typically developing children.

Maternal utterances. In the ASD sample, a total of 17 child utterances from 8 mother–child interactions (2.4% of all child utterances) and a total of 9 control points from 7 mother–child interactions (1.6% of all control points) were excluded from maternal utterance analyses due to no maternal utterances occurring in the 10 s preceding the child utterance or control point. In the typical sample, a total of 8 child utterances from 6 mother–child interactions (0.9% of all child utterances) and a total of 5 control points from 3 mother–child interactions (1.6% of all control points) were excluded from maternal utterance analyses due to no maternal utterances occurring in the 10 s preceding the child utterance or control point.

Base rates of each type of maternal utterance were compared between the ASD and typically developing samples using one-way analyses of covariance (ANCOVAs) with ASD status as a between-subjects factor. These analyses indicated that mothers of children with ASD accompanied follow-in language with an orienting cue significantly more often than mothers of children with typical development (ASD: M = 55.22%, SD = 18.34%; Typical: M = 29.12%, SD = 12.24%), $p < .01$. No other differences were detected between groups. Base rates of each type of maternal utterance are reported in Table 2.

Types of maternal utterances that precede child language use. Following these preliminary analyses, we conducted a 2 × 2 × 2 repeated-measures mixed-model ANCOVA with relationship to child's focus of attention (follow-in vs not follow-in) and degree of demandingness (demanding vs non-demanding) as within-subjects factors and ASD status as a between-subjects factor. For both within-subjects factors, the difference scores between percent occurrence before child utterances and control points were used for this analysis.[2]

The ANCOVA indicated main effects of degree of demandingness, $F(1, 41) = 44.84$, $p < .001$, and relationship to child's focus of attention, $F(1, 41) = 6.020$, $p < .05$. These main effects were qualified by a significant interaction between degree of demandingness and relationship to child's focus of attention, $F(1, 41) = 20.396$, $p < .001$. Finally, an interaction between degree of demandingness and ASD status was detected $F(1, 41) = 4.845$, $p < .05$. Follow-up paired samples t-tests comparing means for each of the four language categories using a Bonferroni correction indicated significant differences between all pairs except the demanding not follow-in/non-demanding not follow-in pair ($p < .001$), suggesting that the main effects were driven largely by follow-in demanding maternal utterances being more likely to precede child speech compared to all other types of maternal utterances. See Table 3 for full ANCOVA results. See Figure 3 for graphical representation of interaction.

To examine whether children's likelihood of verbally responding differed by mothers' use of orienting cues, we conducted a 2 × 2 × 2 mixed-model repeated-measures ANCOVA with use of orienting cues (zero vs one or more) and relationship to child's focus of attention (follow-in versus not follow-in) as within-subjects factors and ASD status as a between-subjects factor. This ANCOVA detected a significant two-way interaction between number of cues and ASD status, $F(1, 34) = 7.087$, $p < .05$, such that mothers' use of orienting cues was more likely to precede child speech in children with ASD as compared to children with typical development (see Figure 4).

To examine whether children's likelihood of verbally responding differed by the type of prompt mothers used, we conducted a 2 × 2 mixed-model repeated-measures ANCOVA with type of prompt (language, play, and other) as a within-subjects factor and ASD status as a

Table 2. Percentage frequency of maternal utterance types preceding control points and child language points, by diagnostic category.

	ASD		Typical	
	M (*SD*), *Range* Control points	M (*SD*), *Range* Child language points	M (*SD*), *Range* Control points	M (*SD*), *Range* Child language points
Follow-in[a]	77.34 (15.10), *35–95*	82.49 (15.12), *45–100*	85.45 (10.56), *55–100*	88.19 (9.19), *60–100*
Redirecting[a]	22.66 (15.10), *5–65*	17.51 (15.12), *0–55*	14.55 (10.56), *0–45*	11.81 (9.19), *0–40*
Demanding[a]	54.98 (15.47), *30–95*	72.11 (17.79), *33–100*	57.18 (13.55), *30–80*	66.74 (15.80), *26–82*
Non-demanding[a]	45.02 (15.47), *5–70*	27.89 (17.78), *0–67*	42.82 (13.55), *20–70*	33.26 (15.80), *18–74*
Follow-in				
Demanding[a]	38.47 (15.87), *15–68*	57.58 (19.61), *14–100*	45.51 (11.37), *25–65*	56.06 (19.05), *0–78*
Non-demanding[a]	38.87 (16.43), *0–68*	24.91 (16.32), *0–57*	39.94 (14.09), *20–70*	32.13 (16.40), *17–74*
Redirecting				
Demanding[a]	16.51 (9.03), *5–35*	14.53 (12.38), *0–48*	11.66 (7.62), *0–30*	10.67 (9.19), *0–40*
Non-demanding[a]	6.15 (7.39), *0–30*	2.98 (5.37), *0–20*	2.88 (4.50), *0–15*	1.14 (1.55), *0–5*
Follow-in				
No orienting cues[b]	44.78 (18.34), *13–89*	36.90 (23.54), *0–79*	70.88 (12.24), *47–94*	67.46 (15.44), *33–100*
1+ orienting cues[b]	55.22 (18.34), *11–88*	63.10 (23.54), *21–100*	29.12 (12.24), *6–53*	32.54 (15.44), *0–67*
Redirecting				
No orienting cues[b]	33.25 (27.30), *0–100*	19.03 (22.06), *0–75*	26.67 (19.29), *0–50*	35.63 (33.27), *0–100*
1+ orienting cues[b]	66.75 (27.30), *0–100*	80.97 (22.06), *25–100*	73.33 (19.29), *50–100*	64.37 (33.27), *0–100*
Demanding[c]				
Verbal prompts[b]	49.80 (18.50), *0–86*	78.64 (15.80), *29–100*	59.80 (25.35), *13–100*	71.56 (23.77), *0–96*
Play prompts[b]	29.13 (15.74), *0–64*	12.03 (9.18), *0–33*	28.52 (22.00), *0–70*	20.07 (15.98), *4–60*
Other prompts[b]	21.07 (16.21), *0–60*	11.51 (14.18), *0–50*	12.82 (9.75), *0–33*	9.39 (13.13), *0–50*

ASD: Autism spectrum disorder; *SD*: standard deviation.
[a]Percentage of all points.
[b]Percentage of within-category (follow-in, redirecting, demanding) points.
[c]Total may exceed 100% as categories are not mutually exclusive.

between-subjects factor. This ANCOVA detected significant main effects of prompt type, $F(2, 82) = 26.682$. Follow-up pairwise comparisons using paired samples t-tests with Bonferroni corrections indicated differences between language prompts and play prompts, $p < .001$, and between language prompts and other prompts, $p < .001$, such that language prompts were more likely to precede child utterances than either play prompts or other prompts.

Discussion

Results of this microanalysis indicated that maternal utterances that follow a child's focus of interest and also make a demand on the child to use language were most likely to be followed by appropriate child language. This was true for both children with ASD and children with typical development. In addition, for children with ASD only, maternal utterances that were accompanied by an additional orienting cue (e.g. saying the child's name, touching the child, and withholding a toy from the child) were more likely to be followed by appropriate child language. These findings suggest that when mothers of children with ASD follow their child's focus of interest, prompt the child to use language, and support the child's joint attention by providing an orienting cue, the child is most likely to verbally respond.

Maternal language styles

Overall, maternal language patterns were similar in mothers of children with ASD and children with typical development. Mothers in both groups used primarily follow-in language, suggesting that, in our sample, mothers were adept at identifying and joining their children's current interests. Given that our sample consisted largely of highly educated, middle-to-upper-income mothers, a group that has generally been found to be highly responsive to their children, this finding is unsurprising (e.g. Feiring and Lewis, 1981; Richman et al., 1992). The finding of similar language patterns in mothers of children with ASD and children with typical development is also consistent with previous research suggesting similar levels of responsiveness across these groups (Siller and Sigman, 2002). In both groups, mothers' follow-in language was split relatively evenly between demanding and non-demanding language, indicating that mothers frequently comment on their children's current play as well as make requests about their

Table 3. Results of ANCOVAs.

	F	*df*	*p*	Partial η²
Model 1				
Main effects				
Relationship to child's focus of attention	6.02	1, 41	.018*	.128
Degree of demandingness	44.84	1, 41	< .001*	.522
Two-way interactions				
Attention*PLS-4 expressive	1.726	1, 41	.196	.040
Attention*ASD status	0.001	1, 41	.982	<.001
Demandingness*PLS-4 expressive	0.995	1, 41	.324	.024
Demandingness*ASD status	4.85	1, 41	.033*	.106
Attention*Demandingness	20.40	1, 41	< .001*	.332
Three-way interactions				
Attention*Demandingness*PLS-4 expressive	1.25	1, 41	.269	.030
Attention*Demandingness*ASD status	3.02	1, 41	.090	.069
Model 2				
Main effects				
Orienting cues	3.176	1, 34	.084	.085
Two-way interactions				
Orienting Cues*PLS-4 Expressive	1.368	1, 34	.209	.046
Orienting Cues*ASD status	7.087	1, 34	.012*	.172
Three-way interactions				
Attention*Orienting Cues*PLS-4 Expressive	0.427	1, 34	.518	.012
Attention*Orienting Cues*ASD Status	1.846	1, 34	.183	.052
Model 3				
Main effects				
Prompt type	26.68	2, 82	<.001*	.394
Two-way interactions				
Prompt type*PLS-4 Expressive	2.947	2, 82	.058	.067
Prompt type*ASD status	.937	2, 82	.396	.022

ANCOVA: analysis of covariance; *df*: degrees of freedom; PLS-4: Preschool Language Scale, 4th Edition; ASD: autism spectrum disorder.

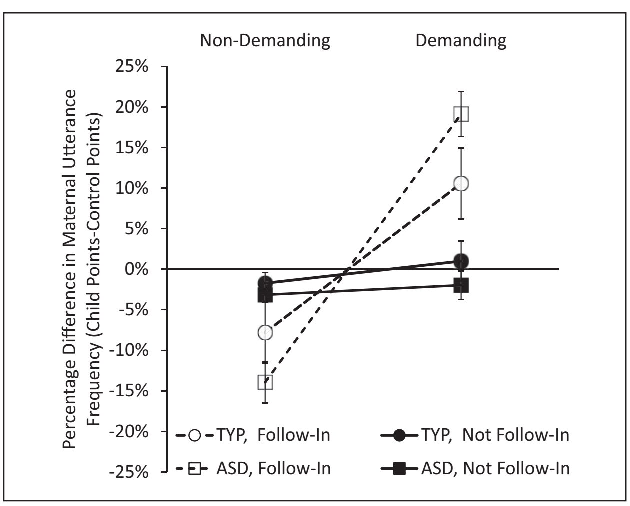

Figure 3. Significant ($p < .001$) interaction between degree of demandingness and relationship to child's focus of attention and between degree of demandingness and ASD status ($p < .05$). Positive values indicate that a maternal utterances type is more likely to be followed by child language; negative values indicate that an utterance type is less likely to be followed by child language. Error bars represent SEM.
ASD: autism spectrum disorder; SEM: standard error of the mean.

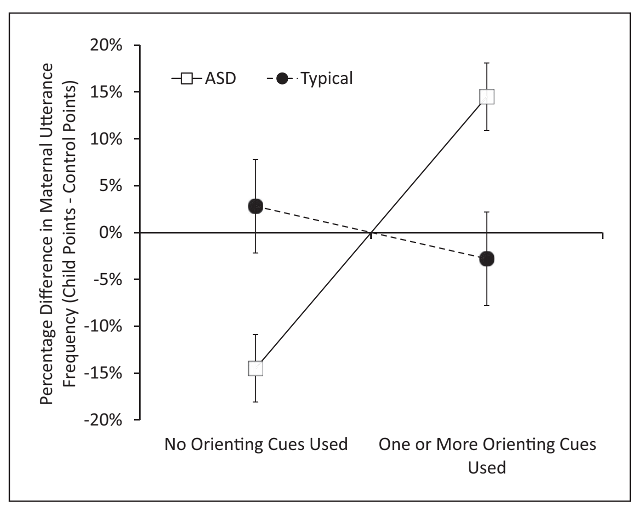

Figure 4. Significant ($p < .05$) interaction between ASD group status and use of orienting cues. Positive values indicate that a maternal utterances type is more likely to be followed by child language; negative values indicate that an utterance type is less likely to be followed by child language. Effect of orienting cues significant for children with ASD, but not for typically developing children. Error bars represent SEM.
ASD: autism spectrum disorder; SEM: standard error of the mean.

children's language and play behaviors. Mothers of children with ASD did use orienting cues to support their children's attention more frequently than mothers of children with typical development. This may be because children with ASD have a more difficult time switching attention between an object and a person during play than do children with typical development (Swettenham et al., 1998). Mothers of children with ASD may notice and attempt to compensate for this difficulty by using additional cues to help their children attend to them during play.

Types of maternal utterances that elicit child language use

For both children with ASD and children with typical development, mothers' use of follow-in demanding language was most likely to precede a child utterance. A variety of previous studies have indicated that parents' use of follow-in language is beneficial for children's language growth *over time* (e.g. Siller and Sigman, 2002, 2008; McDuffie and Yoder, 2010). Consistent with these findings, the results of the current study indicated that maternal follow-in utterances are also likely to elicit appropriate child speech within a single conversational turn.

Previous longitudinal studies have indicated that parents' use of both follow-in demanding language (Haebig et al., 2013; McDuffie and Yoder, 2010) and follow-in non-demanding language (McDuffie and Yoder, 2010; Siller and Sigman, 2002, 2008) may make positive contributions to child language growth over time. In the current study, however, only follow-in demanding language (not follow-in non-demanding language) was found to elicit child speech. This suggests that the mechanisms by which maternal demanding versus non-demanding utterances promote child language growth over time may differ. Follow-in demanding maternal utterances, particularly when they make a demand on the child to speak, may promote long-term language growth by helping children with ASD to use and rehearse emerging speech. In the current study, only maternal follow-in demanding utterances that asked the child to use speech (not language that asked the child to use play or other behaviors) were found to elicit child speech. This result is consistent with Haebig et al.'s (2013) finding that parent language directives, but not parent behavior directives, promoted language growth over the course of 1 year. This similarity between the current findings and longitudinal findings suggests a possible mechanism by which parent's use of follow-in demanding language promotes child speech; this type of parent language may elicit appropriate speech from children, giving them opportunities to rehearse emerging verbal language.

On the other hand, this study found that mothers' use of follow-in non-demanding utterances was unlikely to immediately elicit child speech. However, several longitudinal studies have indicated that this type of maternal utterance is associated with positive child language growth over time (McDuffie and Yoder, 2010; Siller and Sigman, 2002, 2008). This suggests that maternal follow-in non-demanding utterances may promote child language growth via a different mechanism from the verbal rehearsal described above. Instead, it is possible that this type of maternal utterance promotes language by providing new language models (for words or concepts the child does not yet know) and increasing receptive vocabulary, rather than directly eliciting child speech.

The influence of orienting cues

While the types of maternal utterances that promoted language use for children with ASD and children with typical development were largely similar, one notable difference did emerge between groups. For children with ASD (but not children with typical development), mothers' use of orienting cues in conjunction with their language was more likely to elicit child speech. This finding builds on previous literature regarding the benefits of orienting cues for children with ASD. Despite the consistent finding that children with ASD are impaired in their ability to utilize orienting cues such as pointing or having their name called (e.g. Dawson et al., 1998) to establish joint attention with an adult, some literature has found that adding orienting cues may help children at risk for ASD to visually attend to an adult's focus of attention (Presmanes et al., 2007). In addition, Koegel et al. (2009) found that adding an individualized orienting cue (e.g. a high five or specific phrase) to traditional pivotal response treatment helped non-responders acquire first words. The present study found that mothers' use of orienting cues during a naturalistic play session increased the likelihood of a child with ASD verbally responding. This finding supports the existing literature, indicating that the types of orienting cues mothers use spontaneously during play interactions with their children with ASD are facilitating meaningful language use in these children.

Clinical implications

These findings have several clinical implications for promoting language learning and use in children with ASD. First, this study indicated that mothers' use of follow-in utterances that make a demand on a child to use language were most likely to be followed by appropriate child utterances. This finding is largely consistent with previous findings from longitudinal studies (e.g. Siller and Sigman, 2002, 2008) that have indicated potential long-term benefits of follow-in, non-directive maternal speech (which would potentially include certain types of prompts, such as modeling a word or using a cloze procedure) for language growth in children with ASD. It is also consistent with recent finding from a randomized control trial of a responsiveness-based parent training intervention, which found gains in expressive language skills for children with ASD who began the study with lower levels of expressive language skills (Siller et al., 2013). In addition, the current study indicated that mothers' use of orienting cues to accompany their verbal utterances increases the likelihood of children with ASD verbally responding. This finding dovetails well with the results of a recent experimental vocabulary learning study suggesting that using orienting cues when labeling novel objects supports vocabulary learning in children with ASD (Walton and Ingersoll, 2013). Taken together, these findings suggest that interventions that follow a child's lead and provide prompting for language skills, such as pivotal response training (Koegel and Koegel, 2006) and incidental teaching (McGee et al., 1999), may be most beneficial for eliciting speech in children with ASD. Furthermore, the findings related to orienting cues suggest that interventions that use either direct orienting cues (e.g. saying "look" or the child's name before presenting a teaching trial, as in discrete trial training interventions) or indirect orienting cues (e.g. withholding access to toys, using "communicative temptations," as in many blended developmental/naturalistic behavioral models) may help children with ASD attend during play and learning situations and increase their likelihood of verbally responding to adults' prompts.

Limitations and future directions

This sample was largely limited to Caucasian, middle-to-upper-class families. In addition, most mothers in this sample followed their children's attention the majority of the time, and balanced demanding and non-demanding language fairly evenly. This makes it difficult to generalize these findings to a sample of mothers with more heterogeneous backgrounds and interaction patterns with their children. For example, this study found that follow-in demanding language was most likely to elicit child speech. However, mothers only used demanding language, on average, about half the time. It is possible that there is an "ideal" balance between demanding and non-demanding language that many of these mothers fell into, and it may not be true that "more is better" as most mothers used both demanding and non-demanding language with relatively equal frequency. Future studies should attempt to include mothers with a wider range of language patterns. Recruiting a sample from a wider range of socioeconomic and educational backgrounds may facilitate this goal.

In addition, this study examined videotaped interactions recorded within a single play session conducted in a laboratory setting. It is likely that mothers' language and play behaviors were influenced by being observed, and that their behavior in the home setting or while alone with their child may be different than the behavior captured on videotape for this study. Furthermore, this study examined only one particular child skill (instances of appropriate language use). It is possible that examining child language in a more nuanced way (e.g. grammatical constructions, vocabulary usage, and mean length of utterance) might further illuminate patterns in mother–child conversation. For example, certain types of demands may be more likely to elicit particular language forms than others. In addition, examining children's use of other skills, such as play skills or social responses, may also provide additional information. While prompts for behaviors other than language did not encourage child utterances in this sample, it is possible that these prompts encouraged the use of other types of skills, such as more advanced play skills or joint attention skills. Future studies that examine the influence of responsiveness in maternal speech on a number of skills may further clarify the relationships between particular types of maternal demands and child behavior across skill sets.

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Notes

1. Instructions for play interaction were changed slightly due to procedural changes in a larger study that children were participants in. Independent samples t-tests were conducted comparing difference scores for all major language categories and language sub-categories between groups receiving different instructions. Significant differences were found only for the redirecting demanding language category, with the mean difference being slightly lower for the social engagement instruction group. Given that this was the only significant difference, and the direction of effect was the same across groups for this category, groups were collapsed for all analyses.
2. Three children with ASD had fewer than five speech acts during the course of the play session. Because of concerns about the psychometric properties of calculating percentages based on so few speech acts, all analyses of variance (ANOVAs) were conducted with these children excluded from the sample. All findings were unchanged from when the full sample was used; therefore, all children were included in the final analyses regardless of number of speech acts.

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