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Look at Mommy: An Exploratory Study of Attention-Related Communication in Mothers of Toddlers at Risk for Autism

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ABSTRACT

Attentional difficulties are evident in children with autism spectrum disorder (ASD). Accordingly, mothers of children with ASD may modify communication to direct their child's attention, and this pattern may generalize to later-born children. This study examined patterns of child-directed communication in 11 mothers of 18-month-old toddlers at heightened risk (HR) for ASD and compared them to 11 low-risk (LR; no first- or second-degree relative with ASD) dyads. Naturalistic interactions at home were coded for communication that captured, directed, or maintained children's attention and/or actions. Results provide preliminary evidence that LR mothers produce more utterances that involve labeling objects and gestures, while HR mothers use more suggestions. Thus, having an older child with ASD may influence maternal behavior with later-born children, even when those children do not themselves manifest obvious ASD symptomatology. Results highlight the need for further research on dyadic interactions between mothers and HR toddlers in larger samples.

When mothers interact with young children, they tailor their communication to the developmental level of the listener (e.g., Gathercole & Hoff, 2007; Iverson, Capirci, Longobardi, & Caselli, 1999; Iverson, Longobardi, Spampinato, & Caselli, 2006; Newport, Gleitman, & Gleitman, 1977). Mothers of children with developmental disabilities make additional modifications to their communications in ways that appear to support the child's understanding. Thus, for example, mothers of children with Down syndrome (DS), a disorder characterized by early-appearing deficits in attention and language development, produce fewer spoken utterances than do mothers of language-matched typically developing (TD) children but accompany speech with gestures in ways that serve to attract and maintain the child's attention to the referent of the utterance (Iverson, Longobardi, & Caselli, 2003).

Later-born siblings of children with ASD are at heightened risk (HR) for an ASD diagnosis (Ozonoff et al., 2011) and for other developmental concerns (e.g., language delay; Charman et al., 2017; Messinger et al., 2013). Given the unique opportunity that the study of HR infants provides for understanding the early emergence and development of ASD symptoms, much of the extant literature on the development of HR infants has been infant-focused. Only a handful of studies have examined early parent-infant interaction in dyads with HR infants (e.g., Wan et al., 2012, 2013). Focusing primarily on maternal interactional style using global behavioral ratings, these studies have reported that, relative to mothers of LR infants, mothers of HR infants were somewhat less responsive to and more directive with their infants.

There has also been very little work on maternal communication to HR infants. This paucity of data is surprising for two reasons. First, the communication of mothers of HR children may be influenced by their history of interactions and experiences with an older

child with ASD. Communicative strategies developed over the course of these interactions could "spill over" into interactions with their later-born children (e.g., Meirsschaut, Warreyn, & Roeyers, 2011; Wan et al., 2012). Second, regardless of whether or not the child eventually receives an ASD diagnosis, many parents of HR infants prospectively report concerns about communicative development as early as 6 months of age (Hess & Landa, 2012; Sacrey et al., 2015; Yirmiya et al., 2006). Such concerns could impact the nature of mothers' communication to HR children.

Surprisingly, only two studies to date have analyzed maternal communication to HR infants and compared it to that of mothers of LR infants (Talbott, Nelson, & Tager-Flusberg, 2015, 2016). The results of these studies are partially consistent with the expectations outlined above. Both sampled maternal communication during the first year (at 9 and 12 months). While there were no group differences in maternal speech production at either age, at 12 months, mothers of HR infants produced more gestures and expressed more meanings in gesture than did mothers of LR infants. The authors suggest that this difference reflects the influence of early parental vigilance and risk status on maternal communication.

The present study

While these initial reports of early-appearing differences in communication between mothers of HR and LR infants are suggestive, they have focused on differences in overall quantity of child-directed maternal communication (speech and gesture). Examination of more qualitative features of maternal communication, especially features that might be expected to reflect experiences parenting an older child with ASD, is an important next step in evaluating the nature of maternal input to HR children.

The overarching goal of the present study was therefore to examine maternal communication to 18 month-old HR and LR toddlers during semi-structured play interactions videotaped in the home. Since mothers of HR toddlers have a history of interacting with an older child with ASD-related attentional difficulties (interactions that are often characterized by more directive maternal communicative strategies; Doussard-Roosevelt, Joe, Bazhenova, & Porges, 2003; Wan et al., 2012) and are also likely to have heightened levels of concern about their later-born child's communicative development (Hess & Landa, 2012; Sacrey et al., 2015), HR mothers may make greater use of strategies to structure and maintain their HR toddlers' attention in order to promote interaction and language learning. Thus, we wanted to explore whether mothers of HR toddlers made more extensive use of *attention-related communication*, or communication aimed at directing the child's attention, compared to mothers of LR toddlers.

There are at least two ways in which maternal communication may direct children's attention. One is through explicit verbal messages that employ attentionally-salient words (e.g., "Look!") or phrases that request motoric action from a child, particularly directives (e.g., "Go get the ball") or suggestions (e.g., "Can you get the ball?"). A second way is through the use of gestures and other nonverbal behaviors such as actions on objects or physical manipulation of the child's body (e.g., tapping the child's leg; repositioning the child so that s/he is looking at a different object). These nonverbal strategies may provide an additional means for directing and maintaining children's attention (e.g., Presmanes, Walden, Stone, & Yoder, 2007), particularly when combined with speech (e.g., "The ball is blue" + POINT to a picture).

Two predictions were generated based on the findings reviewed above: (1) relative to mothers of LR toddlers, mothers of HR toddlers were expected to produce more utterances containing attention-directing speech (e.g., Wan et al., 2012); and (2) relative to LR mothers, HR mothers were expected to produce more utterances consisting of speech accompanied by highly salient nonverbal behaviors, specifically actions on objects and/or behaviors involving touching or moving the child's body (e.g., Presmanes et al., 2007).

Method

Participants

The sample consisted of 22 mother-child dyads who participated in one of three long-term, long-itudinal studies conducted by the second author. Eleven HR toddlers (6 females, 5 males) had an older full biological sibling with ASD. HR dyads were recruited through a university ASD research program, parent support organizations, local agencies, and schools serving families of children with ASD. Prior to each HR infant's enrollment, confirmation of the older sibling's Autistic Disorder diagnosis was obtained through administration of the Autism Diagnostic Observation Schedule (ADOS-G; Lord et al., 2000) by a trained clinician. Older siblings had to score above the threshold for Autism on the ADOS in order for infants to be eligible for study inclusion. At 36 months, all HR toddlers received an outcome assessment conducted by a clinician blind to all previous study data using the ADOS and DSM-IV-TR criteria (American Psychiatric Association, 2000). All HR children in the current study scored below the threshold for ASD.

The comparison group consisted of 11 LR toddlers (6 females, 5 males) with no family history of ASD (i.e., no first- or second-degree relatives diagnosed with ASD) and their mothers. This group was selected to be gender-matched to the HR group and included only later-born LR toddlers from the larger parent project. All of the LR toddlers in this study had an older TD sibling. No developmental concerns were reported for any of these infants during the course of their involvement in the study. We have remained in contact with these families since this time, and no child has subsequently received a diagnosis of any form of developmental disorder (e.g., ASD, language impairment).

All mothers and toddlers in the HR and LR samples were Caucasian and came from monolingual English-speaking homes. Toddlers in both groups were from full-term uncomplicated pregnancies. Mean maternal age at study enrollment did not differ significantly by group (M_{HR} = 32.6, SD = 4.48; M_{LR} = 32.5, SD = 4.90). All mothers had completed college or had some college, and approximately half of all mothers worked part-time or full-time. Family income information was not available, so Nakao-Treas occupational prestige scores (Nakao & Treas, 1994) were calculated as an index of socioeconomic status. Scores were calculated for fathers' occupations because a substantial proportion of mothers in the sample were staying home to raise their children. In four cases (two HR; two LR) we were unable to identify the father's occupation with enough precision to assign a prestige score. Results from the remaining families indicated that mean prestige scores did not differ between groups (M_{HR} = 56.16, SD = 16.11; M_{LR} = 59.76, SD = 6.17; $t(16)$ = .63, p = .540).

Procedure

Toddlers were videotaped at home with their mothers on a monthly basis during the first two years of life. The present study focused on sessions when toddlers were 18 months of age. We selected this age in order to extend prior work on maternal communication in the first year (Talbott et al., 2015, Talbott et al., 2016) and because we felt that attention-related communication would be maximally likely to occur when children were able to locomote and freely explore their environments. Visits were conducted to coincide with the monthly anniversary of the child's birthday. Data were collected during 45-min-long videotaped sessions that involved observation of dyads in two major contexts in fixed order. The first and final 15-min segments consisted of unstructured, naturalistic observation. During this time, mothers were encouraged to continue their daily routines and activities as usual for the time of day at which the visit occurred. Toddlers typically played on the floor with mothers present but not specifically initiating involvement with the child. No specific instructions were provided, with the exception that television or video watching were not permitted. During the middle 15-min segment (i.e., toy play), mothers and their toddlers were seated on the floor and asked to "play as you normally would"; otherwise, there was no attempt to structure this segment in any way. Play during this segment typically involved blocks, Legos, cars, toy kitchen sets, and stuffed animals.

Measures

At 18 months, parents of HR and LR toddlers completed the Words and Sentences form of the MacArthur-Bates Communicative Development Inventory (CDI-II; Fenson et al., 1993). The CDI is a widely used measure of expressive and receptive vocabulary and grammar in both general and HR samples (e.g., Hudry et al., 2014; Zwaigenbaum et al., 2005). It has excellent internal consistency and test-retest reliability, as well as concurrent validity with tester-administered measures (Fenson et al., 1993). There were no differences between HR and LR toddlers in Words Produced raw scores (M_{HR} = 61.36, SD_{HR} = 98.50, Range 4–347; M_{LR} = 118.00, SD_{LR} = 115.84, Range = 11–354; $t(20)$ = 1.24, p = .231) or standardized percentile scores (M_{HR} = 24.55, SD_{HR} = 28.24, Range 0–90; M_{LR} = 44.09, SD_{LR} = 34.27, Range = 5–90; $t(20)$ = 1.46, p = .160).

At 24 months, all HR toddlers were administered the Mullen Scales of Early Learning (MSEL; Mullen, 1995). The MSEL provides a measure of general cognitive functioning from 0–68 months. It consists of five subscales: Visual Reception, Receptive Language, Expressive Language, Fine Motor, and Gross Motor. Internal consistency ranges from 0.83–0.95. Items involve structured tasks, questions, and observation of the child's reaction to stimuli with verbal requirements ranging from none to one to three-word responses to sentence repetition. HR toddlers received standardized T scores in the average range (M = 52.18, SD = 8.13, range 43–67) on the Visual Reception subscale (an estimate of nonverbal cognition; e.g., Kaldy, Kraper, Carter, & Blaser, 2011). The MSEL was not part of the study protocol for LR children and was not administered to them.

Coding

For the present study, a 10-min segment during which both mother and child were on camera was selected from the naturalistic and/or toy play contexts. For the majority of participants, the entire coded segment was derived from either the naturalistic or the toy play segment. However, for four participants (all from the LR toddler group), it was necessary to use a combination of segments from both the naturalistic and toy play contexts in order to obtain a total of 10 min of mother-child interaction with adequate audio and video quality for coding (e.g., both mother and child were visible and audible). All maternal communication produced during this segment was transcribed verbatim and separated into utterances. An *utterance* was defined as a sequence of words and/or gestures preceded and followed by silence or a change in conversational turns or intonational patterns (e.g., Iverson et al., 1999).

All utterances were classified into one of three categories on the basis of their composition (see Table 1 for examples). *Speech only* utterances consisted solely of verbal communication. *Mixed* utterances consisted of speech accompanied by a gesture (pointing, showing, conventional gestures; e.g., beckoning), an action (the use of an object in hand), or a behavior (physical action on the child's body). *Gesture/Action/Behavior only* (G/A/B only) utterances consisted of a gesture, action, or behavior with no accompanying speech. Finally, utterances were coded as *Inaudible* if part of utterance was not comprehensible and the utterance function could not be determined. Inaudible utterances accounted for fewer than 5% of all utterances for both groups and thus were excluded from further analysis.

Next, following the classification system of Konstantareas, Zajdeman, Homatidis, and McCabe (1988; see Table 1 for examples), all utterances containing speech (i.e., Speech only, Mixed) were grouped into one of five categories with regard to their communicative function. *Call to Attention* utterances involved explicit attentional speech, including words such as "Look." *Directive/demand* utterances involved the use of explicit imperatives to direct the child to speak or to respond motorically. *Suggestion* utterances involved the use of less demanding speech, such as: (1) the use of a conditional verb; (2) the proposition of an activity or an object for the child to

Table 1. Maternal attention-related communication coding system.

Type of Speech	Code	Example
Utterance Composition	Speech only	"The dog is brown"
	Mixed + Gesture	"The dog is brown" while pointing at a picture
	Mixed + Action	"Here is your cup" while handing child a cup
	Mixed + Behavior	"Hey you" while tapping the child on the arm
	Gesture only	Mother points at picture of a bear, without any accompanying speech
	Action only	Mother holds out a puzzle piece for the child to take
	Behavior only	Tapping the child to get attention
Attention-directing Speech	Call to attention	Look/Hey/Watch/Listen/You [used alone in a sentence]/See [must be 1st word in utterance]/name [alone]/There/There (name)/Here/Here (name)
	Directive/demand	"Bring mom your doll"
	Object labeling	"This is an apple"
	Suggestion	"Should we read a book?"
		"Can we cook it?"
		"Want to play ball"
Residual language	Residual language	"You like to play catch"

take; (3) polite requests for objects; or (4) "polite demands," defined as a demand made in a question format that did not involve a conditional word (e.g., Landry & Chapieski, 1989). *Object Labeling* utterances involved parent identification of an object by providing labels of whole objects or of object parts/characteristics. Together, all Call to Attention, Directive/ demand, Suggestion, and Object Labeling utterances represented *attention-directing speech*. Maternal speech that did not fall into one of these four categories was classified as *Residual Language*. Residual Language utterances were typically general statements made by the parent to the child with no response expected or requests for information, such as "You like to play catch." Inasmuch as these utterances did not have attention-directing properties, they were not included in the analyses reported below. Coding of maternal attention-directing communication was completed independently of children's responses to the communication.

Reliability

To assess inter-rater reliability, a second trained observer who was naive to toddler group member-ship independently transcribed communication for 27% of dyads and coded transcripts for utterance composition and identification of attention-directing speech for 23% of dyads. Mean percent agree-ment for the identification and transcription of maternal utterances was 90% (range = 81–93%). Cohen's kappa (Cohen, 1960) statistics were calculated to assess agreement for classification of utterances into Composition and Function categories. The mean kappas were as follows: Utterance Composition (κ = .96, range = .89–1.0) and Utterance Function (κ = .88, range = .77–1.0). Inter-coder disagreements were resolved by watching relevant segments of the video clips and arriving through discussion at consensus codes. These codes were incorporated in the data analysis following reliability calculations.

Data analysis

Primary analyses involved profile analysis, a special application of MANOVA. This type of analysis is an efficient way to investigate group-level patterns in the composition of several different types of dependent variables (i.e., types of communicative input) measured on the same scale (Tabachnick & Fidell, 2013). Overall, profile analysis aims to answer three questions: (1) Do different groups have *parallel* profiles across the collected set of measures of the dependent variable? (i.e., test of parallelism); (2) Whether or not the profiles are parallel, are scores for one group across the collected set of measures lower or higher on average than those of another

group? (i.e., test of levels); and (3) Do all the dependent variables elicit the same average response, regardless of group? (i.e., test of flatness). In the present study, profile analysis was used to compare group means (i.e., HR vs. LR mothers) for the communication variables of interest. All variables to be reported were calculated as rates per 10 min and averaged across mothers in each group. When profiles being compared were different (i.e., not parallel), simple-effects contrasts were performed to pinpoint sources of difference. Within profiles that differed significantly ($p < .05$), measures were compared between HR and LR groups using independent samples t tests.

Results

Preliminary analysis

Due to slight variations in the amount of time coded during the naturalistic and toy play settings, a preliminary analysis was conducted to ensure that these did not vary systematically by group. This was done by averaging the length of the segments (in seconds) selected from naturalistic ($M_{LR} = 193.45$, $SD = 250.68$; $M_{HR} = 163.64$, $SD = 280.26$) and toy play ($M_{LR} = 403.00$, $SD = 253.64$; $M_{HR} = 436.36$, $SD = 280.26$) segments respectively for LR and HR mothers. Independent sample t tests revealed no group differences in the amount of time coded in either naturalistic ($t(20) = .26$, $p = .80$, Cohen's $d = −.11$) or toy play ($t(20) = −.29$, $p = .77$, Cohen's $d = .12$) contexts.

Utterance composition

Descriptive data on features of child-directed communication produced by HR and LR mothers are presented in Table 2 and Figure 1. Overall, there were no differences in the total numbers of utterances produced by HR and LR mothers ($t(20) = −.16$, $p = .87$), nor were there differences in mean rates of Speech only ($t(20) = −.58$, $p = .57$), Mixed ($t(20) = 1.31$, $p = .21$), or G/A/B only utterances ($t(20) = −.88$, $p = .39$); see Figure 1. The majority of communication for both groups consisted of Speech only, Mixed, and G/A/B only utterances, in that order.

Attention-related communication

Our primary aim was to compare attention-related communication between mothers of HR and LR toddlers, with the expectation that HR mothers would produce more attention-related communication. Two sets of analyses were conducted to address this prediction.

First, we investigated the rate of production of attention-directing speech. Counter to expectation, HR and LR mothers produced comparable rates of attention-directing speech ($M_{HR} = 10.80$, $SD = 5.13$; $M_{LR} = 10.62$, $SD = 6.82$; $t(20) = −.07$, $p = .95$). However, there were group differences in the rates of the four types of attention-directing speech utterances. A profile analysis was conducted to examine attention-directing speech with group as the independent variable (i.e., mothers of HR vs. LR toddlers) and rates of attention-directing speech as the dependent variable. Results indicated that the profiles deviated significantly from parallelism as a function of group status, $F(3,60) = 3.69$, $p = .017$ (see Figure 2). While Calls to Attention and Directive/Demands were produced at similar rates, HR mothers produced more Suggestions, but less Object Labeling, relative to LR mothers.[1] Two post-hoc independent-samples t tests were conducted on the rates of Object Labeling and Suggestion utterances; both differences approached significance (Object Labeling $t(20) = 1.99$, $p = .07$; and Suggestion $t(20) = −1.78$, $p = .09$).

Second, we investigated group differences in production of speech accompanied by highly salient nonverbal behaviors (i.e., mixed utterances) using profile analysis. The independent variable was group (i.e., mothers of HR vs. LR toddlers) and the dependent variable was rate of mixed utterances.

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[1] Given the substantial individual variability in maternal production of the communicative behaviors of interest and the small sample size, profile analysis results were confirmed with nonparametric Mann-Whitney tests. Unless otherwise indicated, results did not differ.

Table 2. Characteristics of utterance composition during the 10-min segment.

	HR mothers		LR mothers		t(20)	p	Cohen's d
	M (SD)	Range	M (SD)	Range			
Total number	159.00 (56.58)	72–284	155.2 (53.37)	98–295	−.16	.87	.07
Utterance Composition Type (rate per 10 min)							
Speech Only	136.27 (56.22)	55–260	124.59 (35.44)	87–207	−.58	.57	.25
Mixed	18.91 (13.43)	1–50	28.74 (21.06)	11–78	1.31	.21	.56
Mixed + Gesture	10.73 (7.42)	1–23	24.82 (19.10)	10–67	2.28	.04	.97
Mixed + Action	6.73 (7.42)	0–26	3.01 (3.09)	0–10	−1.53	.14	.66
Mixed + Behavior	1.45 (1.63)	0–5	.91 (.70)	0–2	−1.02	.33	.43
G/A/B only	3.64 (3.26)	0–11	2.46 (3.01)	0–10	−.88	.39	.37
Attention-directing Speech (rate per 10 min)							
Call to attention	9.00 (6.03)	0–16	6.83 (7.06)	0–25	−.77	.45	.33
Directive/demand	14.18 (9.63)	2–31	13.79 (10.98)	4–43	−.09	.93	.04
Object labeling	2.00 (2.10)	0–7	10.01 (13.20)	0–42	1.99	.07	.85
Suggestion	18.00 (9.48)	2–31	11.83 (6.50)	4–24	−1.78	.09	.76
Residual language	111.36 (43.34)	52–210	109.94 (29.47)	74–110	−.09	.93	.04

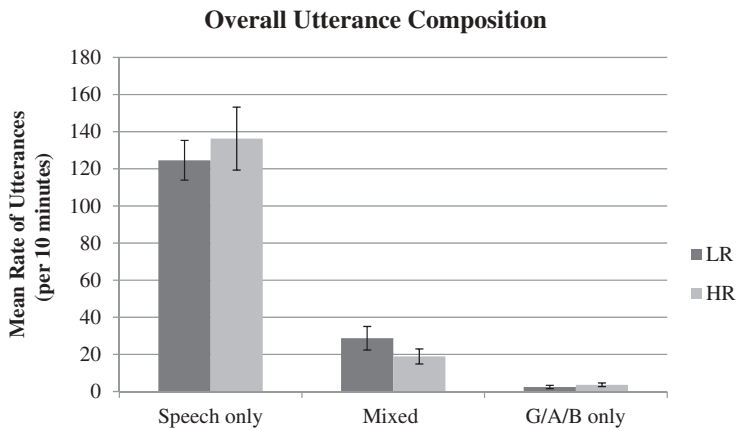*Note.* Mixed = Mixed + Gesture/Action/Behavior; G/A/B = Gesture/Action/Behavior only.

Figure 1. Mean rate per 10 min of overall utterance composition categories for mothers of LR toddlers vs. mothers of HR toddlers. Error bars represent standard errors.
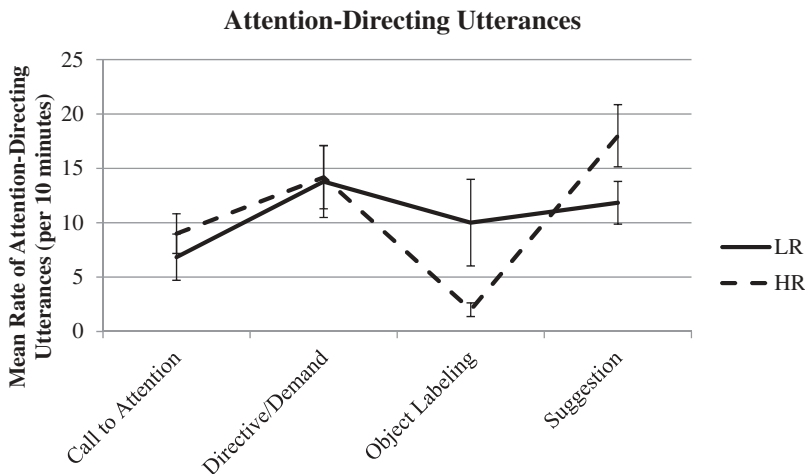

Figure 2. Mean rate per 10 min of attention-directing speech utterances for mothers of LR toddlers vs. mothers of HR toddlers. Error bars represent standard errors.

The profiles of mean rate of mixed utterances appear in Figure 3. Using the Greenhouse-Geisser criterion, the profiles deviated significantly from parallelism, $F(2, 40) = 7.100$, $p = .002$. Two post-hoc independent-samples t tests were conducted on the mean production of Mixed + Gesture and Mixed + Action utterances. Results indicated a significant difference between mothers of HR and LR toddlers in production of Mixed + Gesture utterances, $t(20) = 2.28$, $p = .04$, but in a direction opposite from that predicted. Specifically, mothers of HR toddlers produced Mixed + Gesture utterances about half as frequently as did LR mothers ($M_{LR} = 24.82$, $SD = 19.10$; $M_{HR} = 10.73$, $SD = 7.42$). No significant group differences emerged for Mixed + Action utterances.

Discussion

This exploratory study aimed to use a novel coding system to describe and compare attention-related communication produced by mothers of 18-month-old HR and LR toddlers. The sample size was relatively small, and therefore results should be considered preliminary, although they clearly merit replication with larger groups of participants.

The majority of communication for both groups of mothers involved speech only, followed in order by mixed utterances (i.e., speech + a gesture, action, or behavior) and utterances that involved only a gesture, action, or behavior. Results are consistent with those of Iverson et al. (1999), who found that the majority of utterances produced by mothers of TD children consisted of speech only, speech with gesture, and gesture only, in that order. The consistency between the present study and Iverson et al. (2006) is important, suggesting that the communicative patterns displayed by mothers may be stable features of child-directed communication.

The data did not support our hypothesis that HR mothers would produce more attention-related speech than LR mothers. This was surprising given evidence that HR mothers appear to attend carefully to and are likely to be concerned about their later-born children's communication skills (e.g., Hess & Landa, 2012; Sacrey et al., 2015). Additionally, we did not find that HR mothers produced more utterances consisting of speech accompanied by actions on objects and/or touching/moving the child's body. This overall pattern is consistent with research that has found few differences in the communicative behaviors of mothers of children with ASD relative to mothers of TD children (e.g., Bani Hani, Gonzalez-Barrero, & Nadig, 2013; Kasari, Sigman, Mundy, & Yirmiya, 1988; Siller & Sigman, 2002).
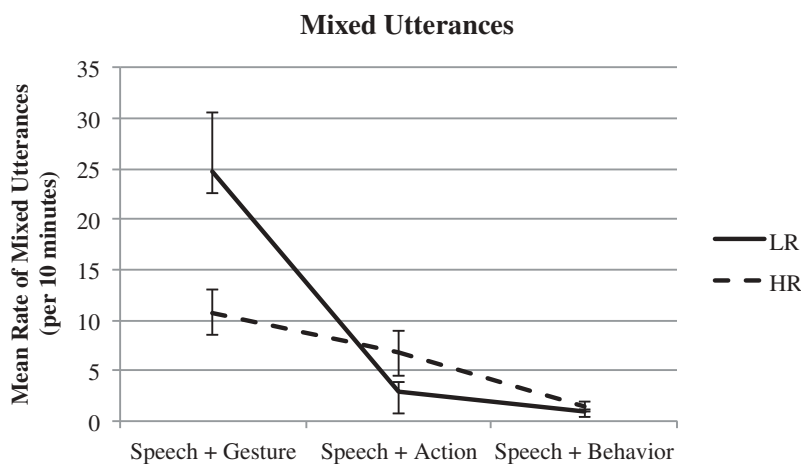

Figure 3. Mean rate per 10 min of mixed utterances for mothers of LR toddlers vs. mothers of HR toddlers. Error bars represent standard errors.

However, HR mothers tended to differ from LR mothers in the production of two specific types of attention-directing speech. Relative to mothers of LR toddlers, mothers of HR toddlers tended to produce more Suggestion utterances, which propose activities through the utilization of a question (e.g., "Should we get your puzzle?"), and fewer Object Labeling utterances (e.g., "That is a ball"). As discussed below, these results may be explained by underlying differences in HR toddlers' communication and gesture production compared to LR toddlers.

First, although the mean Words Produced scores for HR and LR toddlers did not differ significantly, there was wide individual variability in these scores, especially in the HR group, which had more toddlers scoring at the lower end of the distribution (see also Iverson et al., 2018; Iverson & Wozniak, 2007; Landa, Holman, & Garrett-Mayer, 2007; Yirmiya et al., 2006). HR toddlers' relatively lower vocabulary production may explain the lower production of Object Labeling utterances observed among HR mothers. Furthermore, HR mothers' relatively greater use of Suggestions may relate to the previously reported tendency for HR toddlers (even those with no subsequent ASD diagnosis) to initiate spontaneous communication at lower rates than their LR peers (Winder, Wozniak, Parlade, & Iverson, 2013). Suggestions may thus provide mothers of HR toddlers with a way to sustain interactions with their children, who initiate them less frequently, by directing the child's action in a way that supports continued interaction, but in a manner that differs from the imperative nature of Directive/demand utterances.

Second, along similar lines, HR mothers' reduced production of object labeling utterances may be related to previously reported differences in the gesture production of their toddlers (Leezenbaum, Campbell, Butler, & Iverson, 2014; Talbott et al., 2015; Winder et al., 2013; Zwaigenbaum et al., 2005). For instance, Leezenbaum et al. (2014) found that while mothers of 18 month-old HR and LR toddlers were similarly responsive to their children's gestures and equally likely to provide translations of their showing and pointing gestures (i.e., responses that labeled the referent of the child's gesture), HR toddlers produced many fewer showing and pointing gestures. Thus, HR toddlers gave their mothers fewer opportunities to provide responses containing translations. The net result of this difference in toddler communication was that HR toddlers received fewer of precisely the type of response that is known to support language learning—responses that contain a label for the object on which their attention is currently focused.

Additionally, results indicated some differences in rates of speech accompanied by salient non-verbal behaviors. Compared to HR mothers, LR mothers produced significantly more Mixed + Gesture utterances, which provide children with direct object-referent information (Iverson et al., 1999). This is in contrast to evidence from Talbott et al. (2015), who reported that relative to LR mothers, HR mothers produced more gestures when interacting with their 12-month-old infants. It is important to note, however, that the Talbott et al. (2015) study involved a younger sample, and mothers' communicative strategies involving gesture may differ for younger infants. Although no group differences emerged with regard to rates of speech accompanied by actions or behaviors, it is possible that an observation longer than 10 min may provide more opportunities for these utterances to occur, thereby facilitating comparison between HR and LR mothers.

Overall, these exploratory findings underscore the importance of considering variation in maternal communication in the context of dyadic and systems-level factors. What mothers say and do when interacting with their child at a given moment in time is a joint function of child characteristics (e.g., communication and language skills), maternal characteristics (e.g., beliefs about the child's developmental level, concerns about communicative development), and the dyad's history of interactions. When mothers interact with a toddler who infrequently initiates communication and produces fewer communicative signals in general, those differences in toddler behavior impact maternal behavior. Over time, effects on maternal behavior may have cascading developmental effects on both child and maternal communication. When mothers have children who, over time, provide them with fewer opportunities to produce rich linguistic input tailored to the child's current focus, maternal input may be altered to reflect variation in children's communication profiles—for example, by increasing production of Suggestions to maintain interactions (see also Iverson &

Wozniak, 2016, for further discussion). It is possible that HR mothers' increased use of Suggestions could be beneficial for HR toddlers' language development. Indeed, prior research indicates that being less directive is beneficial for children's language development (e.g., Murray & Hornbaker, 1997). On this view, Suggestions may represent a positive communicative strategy employed by HR mothers, a possibility that should be examined in future research.

While the present study provides novel preliminary data regarding the nature of caregiver input to HR vs. LR toddlers, several notes of caution are in order regarding the interpretation of the findings. First, as noted above, caution is warranted in interpreting results due to the small sample size, although it is possible that some null findings were due to low power. Second, all mothers and toddlers in this sample were from well-educated Caucasian families, and results may not be generalizable to other populations. Third, coding was conducted at a single age point, and thus we were unable to examine developmental changes in the nature of attention-related communication and potential relations to later language abilities. Finally, we did not measure toddler attention or vocalizations, nor did we have a measure of HR mothers' experiences with intervention techniques, all factors that may influence their communicative patterns with later-born HR children.

Although our findings should be considered preliminary in light of these considerations, they underscore the need for additional research on maternal communication and language directed to HR infants. Strengths of this study include the novel coding scheme, which allowed for investigation of both verbal and non-verbal attention-directing communicative strategies, and an analytic procedure that is well-suited for this type of data. Future longitudinal research with larger samples and longer observations is warranted to better characterize the nature of attention-directing speech and identify specific communication strategies that may be beneficial for language outcomes in HR and LR toddlers.

Disclosure statement

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References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Bani Hani, H., Gonzalez-Barrero, A. M., & Nadig, A. S. (2013). Children's referential understanding of novel words and parent labeling behaviors: Similarities across children with and without autism spectrum disorders. *Journal of Child Language*, 40(5), 971–1002. doi:10.1017/S0305000912000426

Charman, T., Loth, E., Tillmann, J., Crawley, D., Wooldridge, C., Goyard, D., … Buitelaar, J. K. (2017). The EU-AIMS longitudinal European autism project (LEAP): Clinical characterisation. *Molecular Autism*, 8, 27. doi:10.1186/s13229-017-0145-9

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, 10, 37–46. doi:10.1177/001316446002000104

Doussard-Roosevelt, J. A., Joe, C. M., Bazhenova, O. V., & Porges, S. W. (2003). Mother–Child interaction in autistic and nonautistic children: Characteristics of maternal approach behaviours and child social responses. *Development and Psychopathology*, 15, 277–295.

Fenson, L., Dale, P., Reznick, S. J., Thal, D. J., Bates, E., Hartung, J. P., … Reilly, J. S. (1993). *The macarthur communicative development inventories: User's guide and technical manual.* Baltimore, MD: Paul H. Brookes Publishing Company.

Gathercole, V. C. M., & Hoff, E. (2007). Input and the acquisition of language: Three questions. In E. Hoff & M. Shatz (Eds.), *Blackwell handbook of language development* (pp. 107–123). Malden, MA: Blackwell Publishing.

Hess, C. R., & Landa, R. J. (2012). Predictive and concurrent validity of parent concern about young children at risk for autism. *Journal of Autism and Developmental Disorders*, *42*(4), 575–584. doi:10.1007/s10803-011-1282-1

Hudry, K., Chandler, S., Bedford, R., Pasco, G., Gliga, T., Elsabbagh, M., … Charman, T. (2014). Early language profiles in infants at high-risk for autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *44*(1), 154–167. doi:10.1007/s10803-013-1861-4

Iverson, J. M., Capirci, O., Longobardi, E., & Caselli, M. C. (1999). Gesturing in mother-child interactions. *Cognitive Development*, *14*, 57–75. doi:10.1016/S0885-2014(99)80018-5

Iverson, J. M., Longobardi, E., & Caselli, M. C. (2003). Relationship between gestures and words in children with Down's syndrome and typically developing children in the early stages of communicative development. *International Journal of Language and Communication Disorders*, *38*(2), 179–197. doi:10.1080/1368282031000062891

Iverson, J. M., Longobardi, E., Spampinato, K., & Caselli, M. C. (2006). Gesture and speech in maternal input to children with Down's syndrome. *International Journal of Language and Communication Disorders*, *41*, 235–251. doi:10.1080/13682820500312151

Iverson, J. M., Northrup, J. B., Leezenbaum, N. B., Parlade, M. V., Koterba, E. A., & West, K. L. (2018). Early gesture and vocabulary development in infant siblings of children with Autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *48*(1), 55–71. doi:10.1007/s10803-017-3297-8

Iverson, J. M., & Wozniak, R. H. (2007). Variation in vocal-motor development in infant siblings of children with autism. *Journal of Autism and Developmental Disorders*, *37*(1), 158–170. doi:10.1007/s10803-006-0339-z

Iverson, J. M., & Wozniak, R. H. (2016). Transitions to intentional and symbolic communication. In D. Keen, H. Meadan, N. Brady, & J. Halle (Eds.), *Prelinguistic and minimally verbal communicators on the autism spectrum* (pp. 51–72). New York, NY: Springer.

Kaldy, Z., Kraper, C., Carter, A. S., & Blaser, E. (2011). Toddlers with Autism spectrum disorder are more successful at visual search than typically developing toddlers. *Developmental Science*, *14*(5), 980–988. doi:10.1111/j.1467-7687.2011.01053.x

Kasari, C., Sigman, M., Mundy, P., & Yirmiya, N. (1988). Caregiver interactions with autistic children. *Journal of Abnormal Child Psychology*, *16*(1), 45–56.

Konstantareas, M. K., Zajdeman, H., Homatidis, S., & McCabe, A. (1988). Maternal speech to verbal and higher functioning versus nonverbal and lower functioning autistic children. *Journal of Autism and Developmental Disorders*, *18*, 647–656.

Landa, R. J., Holman, K. C., & Garrett-Mayer, E. (2007). Social and communication development in toddlers with early and later diagnosis of autism spectrum disorders. *Archives of General Psychiatry*, *64*(7), 853–864. doi:10.1001/archpsyc.64.7.853

Landry, S. H., & Chapieski, M. L. (1989). Joint attention and infant toy exploration: Effects of down syndrome and prematurity. *Child Development*, *60*(1), 103–118.

Leezenbaum, N. B., Campbell, S. B., Butler, D., & Iverson, J. M. (2014). Maternal verbal responses to communication of infants at low and heightened risk of autism. *Autism*, *18*(6), 694–703. doi:10.1177/1362361313491327

Lord, C., Risi, S., Lambrecht, L., Cook, E. H., Jr., Leventhal, B., DiLavore, P. C., … Rutter, M. (2000). The Autism diagnostic observation schedule-generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders*, *30*, 205–223.

Meirsschaut, M., Warreyn, P., & Roeyers, H. (2011). What is the impact of autism on mother-child interactions within families with a child with autism spectrum disorder? *Autism Research*, *4*(5), 358–367. doi:10.1002/aur.217

Messinger, D., Young, G. S., Ozonoff, S., Dobkins, K., Carter, A., Zwaigenbaum, L., … Sigman, M. (2013). Beyond autism: A baby siblings research consortium study of high-risk children at three years of age. *Journal of the American Academy of Child and Adolescent Psychiatry*, *52*(3), 300–308 e301. doi:10.1016/j.jaac.2012.12.011

Mullen, E. M. (1995). *Mullen scales of early learning (AGS Edition).* Circle Pines, MN: American Guidance Services, Inc.

Murray, A. D., & Hornbaker, A. V. (1997). Maternal directive and faciliative interaction styles: Associations with language and cognitive development of low risk and high risk toddlers. *Development and Psychopathology*, *9*, 507–516.

Nakao, K., & Treas, J. (1994). Updating occupational prestige and socioeconomic scores: How the new measures measure up. *Sociological Methodology*, *24*, 1–72. doi:10.2307/270978

Newport, E., Gleitman, H., & Gleitman, L. (1977). Mother, I'd rather do it myself: Some effects and non-effects of maternal speech style. In C. E. Snow & C. A. Ferguson (Eds.), *Talking to children* (pp. 109–149). Cambridge, UK: Cambridge University Press.

Ozonoff, S., Young, G. S., Carter, A., Messinger, D., Yirmiya, N., Zwaigenbaum, L., … Stone, W. L. (2011). Recurrence risk for Autism spectrum disorders: A baby siblings research consortium study. *Pediatrics*, *128*(3), e488–e495. doi:10.1542/peds.2010-2825

Presmanes, A. G., Walden, T. A., Stone, W. L., & Yoder, P. J. (2007). Effects of different attentional cues on responding to joint attention in younger siblings of children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 37(1), 133–144. doi:10.1007/s10803-006-0338-0

Sacrey, L. A., Zwaigenbaum, L., Bryson, S., Brian, J., Smith, I. M., Roberts, W., … Armstrong, V. (2015). Can parents' concerns predict autism spectrum disorder? A prospective study of high-risk siblings from 6 to 36 months of age. *Journal of the American Academy of Child and Adolescent Psychiatry*, 54(6), 470–478. doi:10.1016/j.jaac.2015.03.014

Siller, M., & Sigman, M. (2002). The behaviors of parents of children with autism predict the subsequent development of their children's communication. *Journal of Autism and Developmental Disorders*, 32, 77–89.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.

Talbott, M. R., Nelson, C. A., & Tager-Flusberg, H. (2015). Maternal gesture use and language development in infant siblings of children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45(1), 4–14. doi:10.1007/s10803-013-1820-0

Talbott, M. R., Nelson, C. A., & Tager-Flusberg, H. (2016). Maternal vocal feedback to 9-month-old infant siblings of children with ASD. *Autism Research*, 9(4), 460–470. doi:10.1002/aur.1521

Wan, M. W., Green, J., Elsabbagh, M., Johnson, M., Charman, T., Plummer, F., & Team, B. (2012). Parent-infant interaction in infant siblings at risk of autism. *Research in Developmental Disabilities*, 33(3), 924–932. doi:10.1016/j.ridd.2011.12.011

Wan, M. W., Green, J., Elsabbagh, M., Johnson, M., Charman, T., Plummer, F., & Team, B. (2013). Quality of interaction between at-risk infants and caregiver at 12-15 months is associated with 3-year autism outcome. *Journal of Child Psychology and Psychiatry*, 54(7), 763–771. doi:10.1111/jcpp.12032

Winder, B. M., Wozniak, R. H., Parlade, M. V., & Iverson, J. M. (2013). Spontaneous initiation of communication in infants at low and heightened risk for autism spectrum disorders. *Developmental Psychology*, 49(10), 1931–1942. doi:10.1037/a0031061

Yirmiya, N., Gamliel, I., Pilowsky, T., Feldman, R., Baron-Cohen, S., & Sigman, M. (2006). The development of siblings of children with autism at 4 and 14 months: Social engagement, communication, and cognition. *Journal of Child Psychology and Psychiatry*, 47(5), 511–523. doi:10.1111/j.1469-7610.2005.01528.x

Zwaigenbaum, L., Bryson, S., Rogers, T., Roberts, W., Brian, J., & Szatmari, P. (2005). Behavioral manifestations of autism in the first year of life. *International Journal of Developmental Neuroscience*, 23(2–3), 143–152. doi:10.1016/j.ijdevneu.2004.05.001