Abstract. Background, purpose. Language emerges in the context of social interactions that include play. The purpose of the study was to examine how infant language development is related to joint attention, social toy play, and preferences for attention games. Material and methods. To examine how infant language development is related to joint attention, social toy play, and preferences for attention games, we videotaped 153 mothers and their 14-month-olds in a 20-minute laboratory observation that included a high chair task and a free-play session. Joint visual attention and social toy play were coded from the videotapes by trained observers. Mothers rated their own and their infants’ preferences for specific types of play at home. Language items selected from the Bayley Scales of Infant Development were used

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to assess preverbal, receptive, and productive language skills. Results, conclusions. Reciprocal social toy play sequences and preferences for simple and coordinated attention games were related to infant language. Joint attention was related to social toy play interactions and preferences for specific attention games at home, but was not directly related to language skills at 14 months. The results suggest that joint attention skills support coordinated, reciprocal, language rich interactions that foster infant language development.

Key Words: Language Development, Play, Social Interaction, Joint Attention, Mother-child relations.

Native language is learned during naturally occurring everyday social contexts. The contexts that seem particularly important for learning language are those that involve coordinated interactions with another person to establish shared meanings (Bruner, 1983; Hart & Risley, 1995; Vygotsky, 1934). Around the end of the first year, these everyday social contexts typically include social toy play and joint attention to objects. Social toy play, in which infants and caregivers coordinate their interactions to share or exchange objects, involves joint attention, in which infants and caregivers coordinate their attention to the same objects (Carpenter, Nagell, & Tomasello, 1998; Newland, Roggman, & Boyce, 2002; Roggman, Boyce, & Newland, 2000; Tomasello, 1995; Tomasello & Farrar, 1986; Tomasello & Todd, 1983). Within the context of social toy play, infants are most likely both practicing and building joint attention skills that facilitate language learning (Bruner, 1983; Mundy & Gomes, 1998; Rollins, Wambacq, Dowell, Mathews, & Reese, 1998; Saxon, Frick, & Colombo, 1997; Tamis-LeMonda & Bornstein, 1989; Tomasello, 1990). Because social toy play and joint attention offer infants opportunities to learn language, variations in these contexts are important to examine in relation to children’s developing language skills.

By coordinating their attention or sharing objects like toys with others, infants establish shared meanings, interpret the intent of communication from the context, and experience more language (Bruner, 1977, 1983; Carpenter et al., 1998; Tomasello & Farrar, 1986). Both social toy play and joint attention occur in the context of highly routinized language learning “formats” (Bruner, 1995; Ratner & Bruner, 1978). Coordinated interactions with objects during routine play interactions contribute to
early language learning because they “make language acquisition possible by creating a shared referential framework within which the child may experientially ground the language used by adults” (Carpenter et al., 1998, p. 24). When mothers and infants mutually focus on an object in joint attention, they speak more frequently, for longer durations, and are more verbally responsive to each other than when they are not mutually attending to an object (Tomasello & Farrar, 1986).

Several key features of joint attention have been identified (Mundy & Gomes, 1998) that are particularly important for language acquisition. When caregivers respond to the infant’s direction of visual attention, maintain the “topic” of visual attention by responding to the objects of attention, talk about the objects of infant attention, and respond to infant initiations of social interaction with objects such as toys in play, infant language skills are greater (Baumwell, Tamis-LeMonda, & Bornstein, 1997; Carpenter et al., 1998; Dunham & Dunham, 1995; Landry, Garner, Swank, & Baldwin, 1996). Thus, these aspects of joint attention that occur during mother-infant social toy play and other contexts appear to support the acquisition of language.

Social toy play and joint attention emerge in development at around the same time. Early adult-infant interactions involve shared meaning or “primary inter-subjectivity,” but the integration of objects into these interactions, between 9 and 12 months, requires more complex coordination of attention and action between the infant and adult. The coordinated interactions with toys and joint attention evident in social toy play, along with the positive affect typically shown in play, suggest the emergence of “secondary intersubjectivity” (Baldwin, 1995; Trevarthan & Hubley, 1978), a component of communication needed for language (Charman, Baron-Cohen, & Swettenham, 2000; Tomasello, 1990). As one aspect of secondary intersubjectivity, joint attention progresses from a) simple overlapping gaze towards the same object to b) following another’s line of visual reference to c) actively directing another’s attention (Carpenter et al., 1998; Carpenter, Pennington, & Rogers, 2002). Incorporating these new attention skills, thus, joint engagement episodes increase dramatically in frequency and duration after 12 months (Adamson & Bakeman, 1985).

Joint attention is more than simple overlapping of attention to the same object, which does not require any awareness of joint attention or
intention of creating it. Even following another’s gaze may be learned simply as a discriminative stimulus, without really comprehending the other’s line of reference (Carpenter et al., 1998). Gaze alternation, or looking back and forth between an object and another person’s eyes, more strongly indicates that an infant is aware of another’s visual perspective. Observations of infants using their locomotion skills to follow an adult’s line of gaze behind a barrier provide even stronger evidence that one-year-olds are aware of another’s visual perspective (Moll & Tomasello, 2004). Once this awareness occurs, following another’s gaze and directing another’s attention becomes intentional by around 12 months and consistent by around 14 months (Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004; Scaife & Bruner, 1975). Although some research suggests that joint attention may not be strongly related to similar behaviors such as pointing, social referencing, and imitation (Tomasello, 1995; Slaughter & McConnell, 2003; Striano & Bertin, 2005), other researchers argue that these behaviors are part of a shared social-communicative representational system that becomes increasingly differentiated into more specific skills including language (Charman et al., 2000).

As infants develop the ability to initiate and maintain joint attention, they are likely to learn more language in social toy play contexts. Infants become more capable of directing adult attention, as their cognitive and attention capacity increases, through intentional use of words or gestures aimed at the adult with the goal being to change the adult’s behavior or to share the adult’s attention and interest (Carpenter et al., 1998; Liszkowski et al., 2004; Messinger & Fogel, 1998). At this point, the adult’s role shifts from an initiator and stimulator, using toys to elicit infant attention and maintain joint attention, to more of a supportive partner, letting the infant take the lead in initiating the joint attention sequence (Raver & Leadbeater, 1995; Saxon et al., 2000). The caregiver’s initial responsibility for “getting things going” becomes a responsibility for “keeping things going” by using responsive behaviors to support or extend an infant’s verbal and behavioral attention toward an object. When infants themselves initiate coordinated interactions and attention with toys, their own attention and interpretation of meaning is likely to be enhanced. Thus it is important to examine coordination of attention and action that is initiated by infants separately from that initiated by adults.
Play preferences are likely to change as infants develop increasingly complex joint attention skills (Roggman et al., 2000). For instance, young infants age 6 to 12 months enjoy simple attention games the adult initiates. Games like patty-cake, peek-a-boo, and “so big” are predictable, coordinated, and scripted such that infants know what to expect from the game, but they do not involve objects and require only primary intersubjectivity (Bruner, 1983; Rogoff, 1990). More complex games that require secondary intersubjectivity begin later and include shared pretend play and toy exchanges with a parent, in which infants show, offer, accept, or repeat actions with a toy, such as rolling a ball back and forth. As infants become more skilled at coordinating their own attention, directing another person’s attention, and coordinating their actions with another person, they are likely to increase their preference for games that require these skills. Infants may then become even more likely to engage in these kinds of coordinated interactions. By engaging in more complex play that allows infants to initiate and direct play interactions and by responding positively to the infant’s initiations, caregivers support children’s language development (Newland et al., 2002). Infants who enjoy this kind of play are likely to seek out more opportunities to play in this way and thereby increase their language development.

When caregivers and infants engage in more complex social toy play interactions and prefer similar types of play that require the coordination of attention and actions, infant language skills are likely to be greater. When infants are the ones initiating these kinds of interactions, the context for learning language is likely to be further enhanced. Although any caregiver may have language promoting interactions with infants, we focused on mothers and their infants in this study to examine how individual variations in joint attention, social toy play, and play preferences are related to early language development.

Exploration of how joint attention and other parent-child coordinated interactions together influence infant language development is important for fully understanding the naturally occurring context of language acquisition (Markus, Mundy, Morales, Delgado, & Yale, 2000). Figure 1 presents the proposed conceptual model, with the solid lines in the figure indicating the expected stronger relations between constructs. The dashed lines in Figure 1 represent possible ways by which the foun-
dations of simple attention games and joint attention may contribute indirectly to infant language acquisition.

RESEARCH QUESTIONS

The purpose of this study was to examine mother-infant play in relation to their joint attention and children’s language to address the following research questions. a) How is infant language competence related to specific aspects or types of mother-infant play: joint attention, social toy play, or play preferences? b) Is infant language competence equally related to mother-initiated and infant-initiated interactions, whether joint attention, social toy play, or play preferences? c) Are these different aspects of play—joint attention, social toy play, and play preferences—inter-related? d) How do joint attention, social toy play, and play preferences combine to predict infant language?

METHOD

Participants

Participants in this study included 153 mother-infant dyads (77 male, 76 female infants) who participated in a study conducted in a laboratory setting when infants were 14 months old (mean age = 1; 2.10 in years, months, and days). Most infants came from middle socioeconomic-status households, as measured by the Hollingshead (1975) Four Factor Index, M = 43.67, range of 24.50-63.50, (scores 40-54 are considered middle SES). The average number of children in each family was three.

Procedures

Mothers who had announced the birth of a child in a public newspaper were recruited for this study by letter and then by telephone. Participants provided written informed consent at the scheduled laboratory assessment, and mothers and infants were then videotaped for 20 minutes in the laboratory playroom. During this 20-minute period, there were two 10-minute tasks: a highchair and free-play task. During the highchair task, infants were seated in a highchair with a set of nesting cups. Mothers sat in a chair next to the infants with a questionnaire they were
asked to complete. They were asked to pick up the cups only if the infant dropped all of the cups on the floor. These instructions allowed the mother to talk and interact with the child, while encouraging the child to seek mother’s attention by dropping the cups. Mother-infant joint visual attention was coded from the highchair session.

During the free-play task, the child was allowed to play on the floor with a set of developmentally appropriate toys that were chosen so that a range of developmental levels of cognitive and social play would be elicited, and included a soft book, shape sorter, chain, a phone, plate and teacup, ball, stacking toys, and other manipulative toys. Mothers were simply asked to take their child out of the highchair and take the lid off the toy box. Most mothers then sat in their chair and interacted with the child while completing the survey. This gave the infant a chance to initiate social toy play. Some mothers moved to the floor during the free-play session and fully engaged with the infant, while others remained somewhat distant. Frequency of mother-infant social toy play behaviors was coded from the free-play task.

After the 20-minute play observation, each infant was tested by a trained research assistant using the Bayley Mental Development Index (Bayley, 1969). Only performance on language items from the Bayley was used for this study.

**Measures**

*Parent-toddler play preferences questionnaire.* The Parent-Toddler Play Preferences Questionnaire (Roggman, 1991) is a maternal report measure of mother and infant play preferences for sensory play, pretend play, simple attention games, and coordinated attention games, with each item rated on a 5-point scale ranging from “Don’t do at all” to “Likes a lot.” Simple attention games and coordinated attention games were included in this study. Simple attention games included five items requiring simple overlap of attention, such as naming body parts, point-and-name games, action rhymes, rhymes and songs, and reading books. Coordinated attention games included seven items requiring more coordinated, reciprocal, and sustained attention to an object or game, such as give and take (sharing) games, rolling ball back and forth, helping with small or large motor activities, helping with art or sensory materials
(such as paint, sand, or water), and joint exploration. Internal consistency reliability of maternal report of play preferences was adequate, for infant preferences (.63 for simple and .67 for coordinated attention games) and maternal preferences (.64 for simple and .62 for coordinated attention games). Convergent validity of this measure was previously established by examining the correlation between mother ratings of mother and infant play preferences and infant play in the laboratory (Roggman et al., 2000).

Joint attention. Joint attention at 14 months was coded by two separate observers using computer software that output timed sequential records of looking behaviors. One observer coded mothers’ looking behavior, and the other coded infants’ looking behavior. There were four possible codes: looking at the toys on the high-chair tray, looking at toys on the floor, looking away (at the walls or ceiling), and looking at the face of the other person. Continuous coding occurred for the 10-minute high-chair session, from the time the three nesting cups were set on the tray by the mother until the end of 10 minutes. Any behavior occurring for less than one second was filtered out by the computer to eliminate brief looks away which do not represent significant breaks in attention focus, similar to other studies (Bakeman & Adamson, 1984; Tomasello & Farrar, 1986; Tamis-LeMonda & Bornstein, 1990; Barton & Tomasello, 1991).

Mother and infant looking data were merged via a computer program to allow analysis that detected when the mother and infant were jointly focusing attention on the toys, each other, or looking away, beginning from the moment the nesting cups were set on the highchair tray. Attention codes in this study were checked for reliability, and second-by-second agreement was calculated for each code (25% of the tapes were checked). Average percent agreement for all mother and infant codes was 90%, with the reliability of counts or durations of individual codes ranging from 79% to 98% agreement.

Mother and infant attention frequency and duration codes were used to create variables that encompassed two factors, a) who initiated the overlap of attention by following the other’s visual gaze and b) was the overlap simply a matter of overlapping attention, or was attention coordinated by the infant (the infant looked at the mother’s face intermittently, at least once for more than one second, as an indication that the infant is aware of overlapping attention with the mother) (Carpen-
ter et al., 1998). The analysis procedure for coordinated joint attention allowed us to capture episodes of valid joint attention, in which mother or infant looked at the other’s face before they mutually looked at the toy, indicating awareness of their play partner’s perspective. The initiator was not the first person to look at the toy but the person who followed attention and showed awareness of another’s perspective by first referencing their face. Thus the definition for coordinated joint attention included: (a) referencing play partner’s face before sharing attention to toy and (b) infant gaze shift to mom’s face for at least one second during the bout of coordinated joint attention, to ensure that the infant is in fact aware of the joint attention (even if mom initiated it). The duration ended when either play partner shifted attention away from the play partner’s face or the toys of mutual interest for at least one second. Thus, our measure was quite specific in determining true bouts of visual joint attention.

The following joint attention variables were computed using computer software and the definitions specified. Maternal gaze following: Total frequency of sequences in which mother followed infant looks to the toys; Mother-initiated overlapping attention: Total duration of sequences in which mother followed infant looks to the toys; Mother-initiated coordinated joint attention: Total duration of sequences in which mother looked to the infant’s face and then followed infant looks to the toys, interspersed with infant looks to the mother’s face (at least once for one second or more). Similar variables were constructed for infants, including: infant gaze following, infant-initiated overlapping attention, and infant-initiated coordinated joint attention.

Social toy play. Two coders were trained to code the frequency of social toy play behaviors using pilot-study videotapes, with a training criterion set at 90% or higher for incident-by-incident inter-rater agreement. Accuracy of coding social toy play in this study was maintained by checking 25% of the coded videotapes, with incident-by-incident agreement consistently meeting or exceeding 95%. Social toy play was coded and analyzed in two steps. During step one, the frequency of mutually exclusive sequences of social toy play behaviors was coded from videotapes of the free-play observations. The simple frequency of the following behaviors was coded for both mothers and infants: offers, shows, accepts an offer, acknowledges an offer, returns the toy, exchanges
the toy (adapted from Newland et al., 2002, and Roggman, Langlois, & Hubbs-Tait, 1987). During step two, the total number of initiations (showing or offering a toy that had not been part of a previous ongoing interaction), responses (a positive reaction to toy initiations by acknowledging or accepting a toy), and exchanges (coordinating actions with the play partner by returning toy or continuing an ongoing toy exchange) was computed from these coded variables.

**Language development.** The Mental Development Index of the Bayley Scales of Infant Development (MDI, Bayley, 1969) was used to assess infant language ability. For consistency in the set of items administered to infants in the study, the MDI items were selected to overlap four months on either side of the targeted age, because the Bayley is age specific in months. Therefore, basal and ceiling rules were not followed during administration of items. Rather, each infant was administered all

### Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Language</th>
<th>Joint Attention</th>
<th>Social toy play</th>
<th>Play preferences</th>
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<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>Mean</td>
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<td><strong>Language</strong></td>
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<td>Mean</td>
<td>Mean</td>
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<td>–</td>
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<td><strong>Productive</strong></td>
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<td>–</td>
<td>1.05</td>
<td>.91</td>
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<td><strong>Gaze following</strong></td>
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<td>.49</td>
<td>.58</td>
<td>.59</td>
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<tr>
<td><strong>Overlapping attention</strong></td>
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<td>.41</td>
<td>.76</td>
<td>.72</td>
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<tr>
<td><strong>Coordinated</strong></td>
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<td>10.55</td>
<td>8.23</td>
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<td>5.48</td>
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<td>3.00-20.00</td>
<td>3.00-20.00</td>
<td>6.00-28.00</td>
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</table>
items in the set selected for the 14-month age period. Each item was scored as pass or fail, and some items were scored using either observation or parental report, following the instructions in the testing manual (Bayley, 1969).

For this study, selected items from the MDI that assess aspects of language skill were used to generate a total language score (11 items) and subscales for preverbal (3 items), receptive language (4 items), and productive language (4 items). This method of extracting language items from the MDI has been used in previous studies (Bee et al., 1982; Karrass, Braungart-Rieker, Mullins, & Lefever, 2002; Reznick, Corley, & Robinson, 1997), and scores for the language scale are correlated with other valued measures of language (Siegel, Cooper, Fitzhardinge, & Ash, 1995). The items are identical to items found on the language scale of the Bayley III (Bayley, 2005). Language scores for the 4 scales represented the total number of items passed in each set, and Cronbach’s alpha ranged from .60-.68 for the preverbal, receptive, productive, and total language scales.

RESULTS

Descriptive statistics for all variables are reported in Table 1. The average duration of overlapping attention and coordinated joint attention during the high chair task at 14 months was quite short (less than 1 minute for both mother and infant). However, the range was quite wide, particularly for infant-initiated coordinated attention (0-4.63 minutes), and these variables were positively skewed. There was a great deal of similarity in the frequency of mother and infant social toy play behaviors, as well as in their preferences for simple attention games and coordinated attention games. Further, social toy play variables also tended to be positively skewed. Because most of the variables were positively skewed, with some strong skewing present (i.e., skew > 2), we applied the square root transformation to all variables used in the correlation analyses. This transformation is commonly recommended to minimize the effects of positive skewness on analysis results (i.e., Glass & Hopkins, 1996; Howell, 2007). After this transformation, no variable had a skew greater 2.26, with the majority of variables having a skew less than 2.
Correlations

Bivariate correlations were calculated to examine the associations among research variables. Specific social toy play interactions and preferences for particular play activities were examined in relation to language and joint attention. Maternal initiations of social toy play, as well as responses to infant toy initiations and exchanges with infants, had small but positive associations with infant language scores ($r = .19^* \text{ to } .27^*$). Likewise, infant initiations with toys as well as responses and toy exchanges had small positive associations with productive and total language scores ($r = .16^* \text{ to } .23^*$). Both maternal and infant preferences for simple attention games are related to infant language scores, particularly preference for specific games that require overlapping attention such as point-and-name games, naming body parts, and reading books ($r = .16^* \text{ to } .28^{**}$). Maternal and infant preferences for more coordinated games with infants, such as give-and-take games, were also associated with infant language ($r = .20^* \text{ to } .32^{**}$).

Mother-infant social toy play and play preferences were also related to the frequency and duration of joint attention episodes. Joint attention was related to both mother and infant responses and exchanges during social toy play, as well as maternal initiations with toys ($r = .16^* \text{ to } .29^{**}$). Of particular interest is the fact that infant-initiated coordinated attention was related to the frequency of both mother and infant responses and exchanges with toys, and the frequency of maternal initiations ($r = .16^* \text{ to } .27^{**}$). Infant-initiated coordinated joint attention was also related to infant preferences for point-and-name games and reading books, as well as more complex attention games such as give-and-take games and tossing a ball back and forth ($r = .17^* \text{ to } .23^{**}$).

Structural Equation Analyses

To reduce the number of variables in our model, we summed scores across variables that were conceptually related. Mother and infant variables were collapsed into single factors, both to account for the bi-directional nature of these play activities and to take into account the results of the bivariate analyses. The resulting factor scores were used in a structural equation model to construct a parsimonious model of the joint contributions of mother-infant play preferences, joint attention, and so-
cial toy play to infant language development. Means were imputed for variables with missing data. The Joint Attention factor consisted of the total of the six joint attention variables, gaze following, overlapping attention, and coordinated joint attention, for both mother and infant. The Social Toy Play factor consisted of the total of six joint social toy play variables, initiations, responses, and exchanges for both mother and infant. The Simple Attention Games factor consisted of the total of the 10 simple attention play preferences variables, naming body parts, point-and-name games, action rhymes, rhymes and songs, and reading books, for both mother and infant. The Coordinated Attention Games factor consisted of the total of the 14 coordinated attention preferences variables, including general exploration, give and take games, rolling ball back and forth, helping with blocks and puzzles, helping with wagon, swing, or slide, helping with art materials, and helping with water, sand and snow, for both mother and infant. The infant’s total language score was included in the model as the final endogenous variable. Table 2 shows the descriptive statistics, intercorrelations, and Cronbach’s alpha values for the factors used in the structural equation model. The correlations, which are all positive as expected, have been adjusted for measurement error.

To determine if there were any outliers associated with the factor scores, we examined the Mahalanobis distance for each case and used an alpha level of .001 as suggested by Kline (1998), and two cases were removed from the analysis. We then formulated the proposed model as a latent-variable structural model with single indicators representing the

<table>
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<th>Factors</th>
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<td>1. Joint attention</td>
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latent constructs, in order to adjust the path estimates for measurement error. This was accomplished by setting the error variance value for each observed variable equal to the observed variance times the expression one minus the reliability of the variable (Joreskog & Sorbom, 1989). To evaluate model fit, we employed a commonly used analysis strategy that combines model trimming and model building (Kline, 1998).

First, we analyzed a model that included the direct effects represented by the solid and dashed lines in Figure 1. Path estimates that were not statistically significant at the .05 alpha level ($t < 2$) were deleted to create a second model which was evaluated by examining indices that tap different aspects of model fit, including the chi-square statistic, the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), and the standardized root mean square residual (SRMR) (Kline, 1998).

The model was considered to have good fit when the $p$-value for the chi-square test was greater than .05, the GFI and AGFI were each greater than 0.90, and the SRMR, a measure of the typical discrepancy between the observed and model-implied correlations, was less than or equal to 0.05. We then examined path estimates, their statistical tests, and modification indices. The latter indices, computed for each omitted path, estimate the expected improvement (decrement) to the model chi-square.

Figure 1. Theoretical model of the effects of joint attention, social toy play, and play preferences on infant language scores.
if a given path had been included in the model. A value corresponding
to the critical chi-square value at the .05 alpha level with one degree of
freedom (for an omitted path) of 3.84 suggests that the fit of the model
would be improved by adding the path.

Finally, we used a chi-square difference test to compare the fit of the
final model to the fit of the other tested models, with \( p < .05 \) indica-
ting an improved fit. Therefore, the goal of this model fitting strategy
was to arrive at a credible, parsimonious model that exhibited as good
of fit as possible to the data. All model tests reported here were based on
the covariance matrix and estimated using maximum likelihood estima-
tion (Joreskog & Sorbom, 1993).

The recursive model in Figure 1, which included all the solid and
dashed lines, or all possible direct and indirect effects, was tested first. A
model that includes all possible direct effects is known as a saturated
model, which always provides a perfect fit to the data. However, several
path estimates were not statistically significant and were removed from
the model. These paths included all of the dashed lines shown in Figure
1 as well as the path from Coordinated Attention Games to Total Lan-
guage. This revised model was then tested. Whereas the GFI, AGFI, and \( \chi^2(6, N = 130) = 10.47, p = .11 \) supported good model fit the value of the SRMR
for model 2 was too high to be considered indicative of good fit (see
Table 3). In addition, a modification index indicated that adding the path
from Coordinated Attention Games to Total Language was expected to
result in a statistically significant decrease of 4.62 to the overall model

### Table 3. Fit Indices for Nested Sequence of Path Models

<table>
<thead>
<tr>
<th>Model</th>
<th>( \chi^2 )</th>
<th>GFI</th>
<th>AGFI</th>
<th>SRMR</th>
<th>( \chi^2 ) diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All direct effects included</td>
<td>0.00a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Insignificant paths from Model 1 deleted</td>
<td>10.47</td>
<td>0.97</td>
<td>0.92</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>3. One path added back into Model 2</td>
<td>5.71</td>
<td>0.98</td>
<td>0.95</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Difference between Model 3 and Model 2</td>
<td>4.76*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between Model 3 and Model 1</td>
<td>5.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. GFI = goodness of fit index; AGFI = adjusted goodness of fit index; SRMR = stan-
dardized root mean square residual.

a Fit of the saturated model is perfect, by definition.

*\( p < .05 \).*
chi-square. Since this path was initially hypothesized, it was added back into the model.

This final model exhibited good fit, as $\chi^2(5, N = 130) = 5.71, p = .34$, and all other fit indices were in the desired ranges. In addition, no modification index for this model exceeded a value of 3.4. The standardized path estimates, which were all positive, statistically significant, and nontrivial, are shown in Figure 2. Finally, as shown in Table 3, the chi-square test of

### Table 4. Standardized Estimates for the Final Model

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Predictor</th>
<th>Direct</th>
<th>Indirect</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total language ($R^2 = .16$)</td>
<td>Coordinated attention games</td>
<td>.26*</td>
<td>.26*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simple attention games</td>
<td>.16*</td>
<td>.16*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social toy play</td>
<td>.28*</td>
<td>.28*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Joint attention</td>
<td>.15</td>
<td>.15</td>
<td></td>
</tr>
<tr>
<td>Social toy play ($R^2 = .27$)</td>
<td>Joint attention</td>
<td>.52*</td>
<td>.52*</td>
<td></td>
</tr>
<tr>
<td>Coordinated attention games ($R^2 = .32$)</td>
<td>Simple attention games</td>
<td>.57*</td>
<td>.57*</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05.
the difference in fit between models 3 and 2 confirmed that adding the path from Coordinated Attention Games to Total Language resulted in better fit for model 3. In addition, the chi-square test of the difference in fit between models 3 and 1 indicated that the more parsimonious model 3 fit the data essentially as well as the saturated perfect-fitting model.

In the final model, Joint Attention predicted Social Toy Play, Simple Attention Games predicted Coordinated Attention Games, and Total Language was predicted by direct paths from Coordinated Attention Games and Social Toy Play. The model accounted for 27% of the variation in Social Toy Play, 32% of the variation in Coordinated Attention Games, and 16% of the variation in Total Language (see Table 4). In addition, the strongest direct effects on Total Language were from Coordinated Attention Games and Social Toy Play. There was also a smaller indirect effect of Simple Attention Games on Total Language. Although the indirect effect of Joint Attention on Total Language was not significant, Joint Attention did have a strong direct effect on Social Toy Play which had the strongest direct effect on language. A preference for Simple Attention Games was a strong predictor of a preference for Coordinated Attention Games.

**DISCUSSION**

Specific interactions within social toy play were related to infant language in this study. In particular, both maternal and infant initiations with toys and responses to the other’s initiations during play were related to concurrent infant language development. These findings support the premise that mothers are scaffolding play by “getting things going” (initiating joint interactions with toys) as well as “keeping things going” (responding to infant toy initiations) at 14 months. They also suggest that mothers are using responsive behaviors during play to extend their infants’ attention and encourage their infants to initiate play (Raver & Leadbeater, 1995). Actual toy sharing or exchanges were weakly related to infant language in this study. However, the average number of exchanges initiated by either mother or infant was quite low, suggesting that this type of play requires more advanced attention skills that are still developing at 14 months, such as the ability to sustain coordinated attention for longer periods of time (Carpenter et al., 2002).
Mother and infant preferences for simple and coordinated attention games at home were also related to infant language competence in this study. Overall, both mother and infant play preferences were related to infant language competence, but infants’ preferences for particular types of play tended to be more strongly associated with their language skills than were maternal play preferences. Both maternal and infant preferences for simple routines requiring short bouts of joint attention, such as naming body parts and point and name games, were related to infants’ receptive and productive language scores at 14 months. Both mother and infant preferences for give and take games were associated with infants’ preverbal language skills, such as using gestures and imitating words, as well as with their total language skills. In addition, infant preferences for simple attention games were more consistently related to their receptive language, whereas their preferences for more complex attention games were related to productive language. Thus, in addition to an overall association between general kinds of play activities and infant language competence, mother and infant preferences for particular activities were also associated with specific language skills.

Findings from this study are similar to those from past research showing relations between the frequency of coordinated attention games requiring joint attention and receptive vocabulary at the end of the first year and (Rollins & Snow, 1998; Rollins et al., 1998). Joint attention was not directly related to language development at 14 months in this study, which is consistent with previous studies that found no concurrent association between joint attention and language across the first year, yet found a lagged association with language development later in the second year (Markus et al. 2000; Saxon et al., 2000; Saxon & Reilly, 1999). Perhaps maternal attention following or switching at this early time point is not strongly related to language because infants are not yet reliably coordinating their attention (Saxon, 1997). Simple overlapping attention, rather than maternal gaze following, seems to be influential when infants are first learning how to organize attention. As infants develop the ability to coordinate and direct attention, maternal attention following becomes more important. Infant language skills are related to their own attention-coordinating skills (Markus et al., 2000), which may have more influence on their language acquisition.
The different aspects of play investigated in this study—joint attention, social toy play, and play preferences—were inter-related. Joint attention measures were associated with social toy play interaction measures. Although these correlations are not indicative of the direction of effect, they are in line with past research that indicates that joint attention lays the foundation for more complex social interactions. For instance, Carpenter et al. (2002) found that most infants typically develop these patterns of interactions first by sharing, then following another’s attention, following another’s behavior, directing another’s attention, and finally by directing another’s behavior. That pattern is applicable to the findings in this study. Infant ability to follow their mother’s gaze, one of the first attention skills to develop, was related to the frequency of mothers’ initiations with toys, infants’ responses to those initiations, and mothers’ initiations of toy exchanges during play. Although infant attention directing (e.g., pointing) was not measured in this study, maternal gaze following was related both to toy exchanges and to preferences for point and name games. Joint attention was not related to infant initiations with toys in this study. However, infant coordinated attention was related to the frequency of mothers’ responses and exchanges during social toy play suggesting that infants who could coordinate their attention could also direct their mothers’ behavior.

Joint attention was also related to the kinds of play mothers and infants preferred. Infant coordinated attention was related to infant preferences for simple attention games. Infant coordinated attention, but not simple overlapping attention, was also related to more complex attention games such as coordinated ball play and give-and-take games. Thus these results support the notion that multiple skills are developing concurrently as infants gain more complex attention and action skills, and mothers typically adapt to these increases in competency. It is probable that as infants become more competent, they engage in increasingly complex social interactions that in turn facilitate the development of more complex joint attention skills and further facilitate language learning. Bruner (1995) suggests that joint attention skills develop in the context of reciprocal “language games,” in which both joint attention and infant goal-seeking are occurring in “routine formats” such as book reading. Parental scaffolding within these routines facilitates a child’s un-
derstanding of both the language and the cultural conventions surrounding language learning (Vygotsky, 1934).

This study involved the examination of language development within naturally occurring everyday social contexts that involved mutual engagement in play. Cross-cultural studies have identified cultural differences in mother-infant play patterns. Bornstein, Haynes, Pascual, Painter, and Galperin (1999) found that Argentine mothers engaged in more social play with their children than did U.S. mothers, but proposed that dyadic as well as cultural factors influence play. Goncu, Mistry, and Mosier (2000) also found that the frequency of social play varied across cultures, but U.S. and Turkish caregivers engaged in more social play than Guatemalan and Indian caregivers. Even though social play was evident in each of the four cultures studied, the play partners, themes, and specific play activities varied. Akhtar (2005) suggests that in some cultures, the kinds of reciprocal and mutually focused interactions examined in joint attention studies are in fact rare. Therefore, other mechanisms may also account for children’s ability to learn language, and further cross-cultural investigations are necessary to examine cultural variations in how infants learn to establish shared meanings and to interpret verbal communication during interactions with their caregivers.

One of the strengths of this study is the relatively large sample size, compared to similar studies of mother-infant joint attention and play, allowing sufficient power to detect true associations among variables. A second strength is the use of multiple measures of mother and infant play both in the laboratory as well as the home setting. The similar pattern of associations between coded play in the lab and maternal report of play in the home strengthens these findings and broadens their generalizability. A third strength is that this study examined both joint attention and the coordinated, highly routinized play interactions originally described by Bruner (1983) as a primary context for early language acquisition. A final strength is that this study examines the development of joint attention at a more micro-level, rather than examining broad patterns of association (Carpenter et al., 2002).

This study included the measurement of variables at only one age point in a correlational design that prohibited causal inferences. Although the results are consistent with our hypotheses, further research that uses experimental research methodology is needed to confirm the
directionality of associations. Although the relatively brief structured laboratory observations may limit the ecological validity of the results, our observations were structured to be similar to everyday mother-infant play activities and the standardized procedures increased both the likelihood that the target behaviors would occur and the reliability of coding those behaviors (Leyendecker, Lamb, & Schölmerich, 1997). Because of the challenge of eliciting and coding joint attention, standardized lab observations of joint attention and social cognitive skills are quite common (Carpenter et al., 2002; Markus et al., 2000). In addition, the likelihood of interruptions and distractions that would occur in a home observation was reduced in the laboratory setting, which strengthened the internal validity of the study (Pedhazur & Schmelkin, 1991; Roggman et al., 2000). Further research should extend these results to naturalistic settings with longer observation periods to increase the ecological validity of the findings from this study.

As suggested by this study and others, the synchronicity between infant development and maternal supportive behaviors that help infants direct and coordinate their attention can have important impacts on infant language learning (Tomasello & Farrar, 1986). Developmental changes in infant ability to engage in joint attention are related to corresponding maternal behaviors, such as the encouragement of attention (Karrass et al., 2002). Markus, et al. (2000) discuss the need to explore the transactional process of caregiver-infant interaction and joint attention and the resulting impacts on child language. Our results support a model in which early language acquisition is facilitated by infant’s social toy play interactions with mothers that are both responsive to infant initiations and adaptive to infant development.

These findings are in line with systems theory, which suggests that patterns of development are emergent and not programmed into the system. These micro-level interactions between mother and child that develop in typical patterns illustrate the essential nature of systems theory; “The physical and social context of the developing animal is more than just a supportive frame; it is an essential component of the assembled system.” (Thelen, 1993, p. 113). In dynamic systems, no individual element can be assumed to be causal without consideration of the system as a whole (Fogel, 1999). While we have examined mother-infant interactions on a micro-behavior level, it is only to clarify the pat-
terns of interrelatedness among different aspects of play, attention, and language. A mother’s responsiveness is not independent of her infant’s elicitation of that responsiveness, but rather, both are part of a complex mother-infant interaction system.

References


Hollingshead, A. B. (1975). *The four factor index of social status*. Unpublished manuscript, Yale University. (Available from A. B. Hollingshead, Department of Sociology, Yale University, New Haven, CT 06520).


month-olds point to share attention and interest. Developmental Science, 7, 297-307.


ŽAIDIMAS IR DĖMESYS: ANKSTYVOSIOS KALBOS SOCIALINIAI PAGRINDAI

Lisa A. Newland, Lori A. Roggman, Keenan A. Pituch


Pgrindiniai žodžiai: kalbos vystymasis, žaidimas, socialinė sąveika, kompleksinis dėmesys, motinos–vaiko ryšiai.

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