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Joint attention and word learning in Ngas-speaking toddlers in Nigeria*

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ABSTRACT

This study examines infants' joint attention behavior and language development in a rural village in Nigeria. Participants included eight younger (1;0 to 1;5, *M* age = 1;2) and eight older toddlers (1;7 to 2;7, *M* age = 2;1). Joint attention behaviors in social interaction contexts were recorded and coded at two time points six months apart. Analyses revealed that these toddlers were producing more high-level joint attention behaviors than less complex behaviors. In addition, the quality and quantity of behaviors produced by these Nigerian children was similar to those found in other cultures. In analyses of children's noun and verb comprehension and production (in relation to the number of nouns or verbs on a parental checklist), parents reported proportionally more verbs than nouns, perhaps because Ngas has some linguistic characteristics that are similar to languages in which a noun

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bias is not seen (e.g. Mandarin Chinese). An examination of the interrelations of joint attention and language development revealed that joint attention behaviors were related to both noun and verb development at different times. The set of results is important for understanding the emergence of joint attention in traditional cultures, the comprehension and production of nouns and verbs given the specific linguistic properties of a language and the importance that early social contexts may have for language development.

Much of what is known about language acquisition concerns language learning in middle-class families in Western cultures. However, some of the most important findings in language development come from studies that demonstrate the range of contexts in which language is acquired. For example, in Kaluli (Schieffelin & Ochs, 1991), infants (before 0;6) are often not treated as conversational partners but are part of a 'triadic' interaction in which the mother speaks for the infant in response to another person's remarks. In addition, in K'iche' Maya (Pye, 1992), parents speak little to their young infants, speaking more to them as they produce more intelligible speech. Even so, most Kaluli and K'iche' Mayan children learn to talk.

One view of these types of findings is that language learning is relatively robust across cultural variation. However, some social contexts within a culture may influence language learning in particular ways. For example, the labeling of objects in English (e.g. Goldfield, 1993) may promote noun acquisition. 'Calling out' routines (i.e. calling to other persons to locate them, identify who they are and/or socialize with them) and repeating routines in the Kwara'ae culture of the Solomon Islands create contexts in which children can anticipate utterances (Watson-Gegeo & Gegeo, 1986), and may help children learn words as part of longer phrases. In contrast, prompting routines (e.g. 'say …') in the Basotho group in South Africa (Demuth, 1986) may support the production of individual words. These and other interactional routines between caretakers and infants may serve as scaffolding (e.g. Bruner, 1983) to encourage word learning in particular ways.

The present study examines a specific social context, joint attention, and investigates whether variations in that context have a specific influence on the acquisition of nouns and verbs. The study was motivated by two major bodies of research. One body of research has examined joint attention behaviors, language development and their interaction. These studies have shown important links between joint attention and language, but have not investigated specific influences on particular word types, nor the relationship between joint attention and language in non-Western,

non-industrialized cultures. A second body of research has examined children's production of nouns and verbs in early vocabularies and related this acquisition to children's cognitive abilities, the linguistic characteristics of their language and the cultural practices that surround them. Some of these studies have included non-Western samples (e.g. Korean, Mandarin Chinese), but none of these studies has included a non-industrialized culture; joint attention has not been considered systematically in this body of research. The present study contributes to both of these bodies of research by examining Ngas children's joint attention behaviors, and the potential relationship between these behaviors and the acquisition of nouns and verbs.

Joint attention, language and their interaction

Joint attention is a specific social skill that appears to be present across many cultures. Object sharing activities have been found in interactions of the !Kung peoples in Botswana (Bakeman, Adamson, Konner & Barr, 1990), and Rogoff, Mistry, Göncü & Mosier (1993) have described a similar phenomena (i.e. 'guided participation') among peoples in Guatemala, India, Turkey and the USA. At the same time, no study has carefully examined joint attention behaviors using attentional categories prevalent throughout the joint attention literature (e.g. Bakeman & Adamson, 1984) in a traditional culture.

Joint attention, or sharing attention to objects, may be an important skill for infants to develop if it helps them to understand that they and the caregiver are both exercising a similar perspective (Bruner, 1995). As infants are in social contexts in which they are treated as agents who have intentions, they may begin to perceive the parent as an agent with intentions, which will help infants to begin to treat an adult's actions and language as intentional. In some sense, all humans (but not other primates) should exhibit joint attention because all humans should be around others who engage in joint attention (Bruner, 1995). On the other hand, there could be cultures in which infants are not treated as agents with intentions. Many studies have examined difficulty in engaging in joint attention by autistic children; to date, no study (including the present one) has examined a culture in which infants are not treated as though they have intentions.

Researchers in language acquisition have viewed joint attention as a necessary prerequisite for language because it may help children and adults share an attentional focus which is likely to correspond to specific words the adult is producing (e.g. Bruner, 1983; Tomasello & Farrar, 1986; Dunham & Dunham, 1992; Baldwin, 1993). Joint attention skills may influence language development as early as the first year of life. Gaze-following ability

in the first year is correlated with the total number of words in infants' receptive vocabulary at 1;0 (Morales, Mundy & Rojas, 1998), the number of object words produced by children aged 0;8 to 1;2 (Slaughter & McConnell, 2003) and their total productive vocabulary after 1;6 (Morales *et al.*, 1998). In addition, infants' pointing gestures at 0;6 have been linked to their receptive language before 1;0 (Harris, Barlow-Brown & Chasin, 1995).

Because infants develop more skillful joint attention behaviors towards the end of the first year (Carpenter, Nagell & Tomasello, 1998), and because word comprehension and production greatly increases after 1;0, the interaction of joint attention and language may be more pronounced after the first year. Mundy & Gomes (1998) found that toddlers' (1;2 to 1;5) ability to respond to joint attention behaviors (i.e. gaze following and pointing tasks) predicted receptive language four months later. They also showed that the number of 'higher-level' joint attention initiations performed by toddlers predicted later expressive language. In a subsequent study (Markus, Mundy, Morales, Delgado & Yale, 2000), infants' ability to respond to joint attention behaviors at 1;0 was correlated with expressive vocabulary size at 1;6. A similar study (Morales *et al.*, 2000) found that a composite estimate of the ability to respond to joint attention behaviors (primarily gaze following) between 0;6 and 1;6 was correlated with both expressive and receptive vocabulary at 2;6. Tomasello & Todd (1983) have also shown that the amount of time infants and their caregivers spend in joint attention episodes earlier in development (between 1;0 and 1;6) is related to children's vocabulary size later in development (after 2;0).

These findings linking joint attention behaviors early in the second year with later language development are supported by one of the most extensive investigations of joint attention behaviors and language (Carpenter *et al.*, 1998). In that study, infants' joint attention (higher levels of joint attention behavior) at 0;11, 1;0 and 1;1 was positively correlated with their word comprehension between 0;9 and 1;3. Infants with an earlier emergence of joint attention (by 1;0) comprehended more words between 0;10 and 1;3 than did children who showed later development of joint attention. In addition, joint attention at 1;2 was correlated with word production at 1;3, 1;6 and 2;0. Furthermore, regression analyses showed that joint attention was a significant predictor of word production between 0;9 and 2;0, with a stronger relationship between joint attention and word production emerging after toddlers could spend a fair amount of time in joint attention.

Most of these studies are correlational in design (though see Tomasello & Farrar, 1986; Dunham, Dunham & Curwin, 1993; also see Baldwin, 1993) and thus cannot address whether joint attention behaviors are causally related to language development. However, studies that have included

cross-lagged correlations (e.g. Tomasello & Todd, 1983; Carpenter *et al.*, 1998) and regression analyses (e.g. Carpenter *et al.*, 1998; Mundy & Gomes, 1998) suggest that joint attention skills develop before referential and expressive language emerges, and that joint attention behaviors predict language skills.

Most if not all of these studies demonstrating a link between joint attention skills and language have been conducted in a single culture. In addition, these previous studies have not examined whether or how joint attention behaviors may be linked to the comprehension and production of words within particular word classes (noun, verb). It is important to consider nouns and verbs separately because joint attention behaviors, which seem to be about sharing attention to objects, may be particularly useful for learning the names for concrete objects. To our knowledge, only one previous study has examined the interaction of joint attention and verb learning (Tomasello & Kruger, 1992). That study shows that children benefit from hearing verbs if a verb is heard either before or after an event, and did not show a similar benefit if a new verb and event occur simultaneously. Thus, joint attention contributes to verb learning, but not because it provides a simultaneous focus on new verb and new action. In addition, given that some verbs require attention to the adult's intentions (e.g. change of state verbs), sharing attention to an object could aid in verb learning if that attention helps them interpret the adult's intentions.

Nouns, verbs and the Ngas

A second reason for differentiating nouns from verbs stems from recent studies that have suggested that, in most (but not all) languages that have been studied, children favor nouns in their early productive vocabularies (Gentner, 1982; Dromi, 1987; Jackson-Maldonado, Thal, Marchman, Bates & Gutierrez-Clellen, 1993; Au, Dapretto & Song, 1994; Tardif, Shatz & Naigles, 1997; Kim, McGregor & Thompson, 2000; Bornstein *et al.*, 2004). Researchers interested in this early pattern in children's productions have discussed cognitive, linguistic and cultural reasons for the early dominance of nouns. A consideration of joint attention suggests an additional way for cultural practices to interact with cognitive and linguistic factors in this development – through variations in the degree to which joint attention behaviors are supported by caregiving practices within cultures.

A cognitive account for an early noun dominance is that the referents for nouns (often concrete objects) are easily preindividuated and are highly coherent (e.g. a table's legs are always present when the top of the table is present), while the referents for verbs are less coherent because they

are distributed across time and space (e.g. the beginning of the action 'kick' must be linked to the subsequent movement of the leg, possible contact with an object and release of the leg). Given these differences in 'packaging' referents, which must then be connected to particular nouns and verbs, there may be cognitive advantages to learning nouns or cognitive difficulties in learning verbs (Gentner, 1982; Gentner & Boroditsky, 2001), which could result in an early productive vocabulary that contains many nouns.

However, there are also differences in the early noun advantage that may in part be related to specific cultural practices of groups. For example, in Chinese (Tardif *et al.*, 1997; Tardif, Gelman & Xu, 1999) and Korean families (Gopnik & Choi, 1995; see also Au *et al.*, 1994; Kim *et al.*, 2000), a cultural focus on the child as a part of a larger social system may lead parents to focus on actions and social roles as opposed to objects (Gopnik & Choi, 1995), while middle-class families in the USA often promote attention to objects or elicit object names (Goldfield, 1993). Although researchers in this body of research have considered some cultural differences, they have not considered cultural practices that may facilitate joint attention behaviors. If joint attention behaviors are linked to language development, a difference in joint attention behaviors as they are shaped by cultural practices will be important to explore.

Considering the cultural practices of the Ngas, it is possible that several aspects of everyday life could have an influence on joint attention. First, infants and toddlers are often carried in a cloth tied to a caretaker's back (facing the back). Thus, they may not be able to follow the gaze of the caretaker as easily (but may be able to look over her shoulder). Moreover, the care of infants and toddlers by older children may influence development if older children are less skilled than are adult caregivers in engaging in behaviors that support joint attention. In Bakeman & Adamson (1984), infants engaged in more 'coordinated joint' behaviors with their mother than with a same-aged peer, but little is known about older children's ability to support joint attention. More generally, because infants are with the caretaker (parent, older sibling) as she conducts her daily activities, and given the nature of these activities outside the home, they should be exposed to a wider variety of speakers than is typically true of Western households. These additional speakers could provide similar opportunities for the infants to engage in joint attention as they would have with fewer speakers or, alternatively, infants could benefit from fewer speakers if they need practice in coordinating attention with particular people. Additionally, the cultural beliefs of caretakers in this culture relevant to language acquisition may differ from those commonly held by middle-class mothers in the USA and Western Europe. In the interactions we observed, caretakers often used commands

to direct infants' activities, which could mean that the infants hear more anticipatory uses of verbs and fewer ongoing comments about objects in view.

In sum, some of the cultural practices of the Ngas could influence the development of joint attention. In addition, these practices may not be as skewed towards nouns as are practices in other cultures. For example, the caretaker is often engaged in other activities (e.g. farming, cooking) and may not be labeling objects as often as is a caretaker who is 'playing' with the infant or is engaged in a book-reading activity (Goldfield, 1993), and there may be fewer objects in the environment to label. With these cultural considerations in mind, we could predict that any 'noun bias' may not be as strong in Ngas as is found in other languages.

In addition to cognitive and cultural factors that may influence joint attention and early vocabulary growth, linguistic properties of a language may promote or discourage particular word types in specific ways. Three linguistic properties that may influence patterns of word learning are the saliency of nouns and verbs in terms of their sentence position, the morphological complexity of nouns and verbs in the language and the frequency of monosyllabic words that are nouns or verbs.

Ngas is a Chadic language in the Afro-Asiatic language family and is spoken by approximately 400 000 people. Most of the research that has been conducted in Africa to date concerns the acquisition of Bantu languages spoken in southern Africa (e.g. Demuth, 1986; Suzman, 1996). Like Hebrew and Arabic, Ngas allows for pro-drop and has a regular system of inflections that can be used to recover the subject that is dropped. Pro-drop languages could advantage verbs because the subjects of sentences (i.e. common and proper nouns, pronouns) can often be omitted and the verb can appear in initial position, making it easier to segment the verb from the speech stream (e.g. Slobin, 1985). However, in a Ngas dropped subject sentence, the verb would appear immediately following a single syllable person–aspect marker. Given the presence of this marker, the ability to drop an initial noun or pronoun in Ngas may not greatly increase the saliency of verbs.

A second linguistic factor that could influence the acquisition of nouns and verbs involves the morphological system of the language. Inflectional systems that are fairly regular and transparent should be easier to acquire as compared to systems with many irregularities or less transparency (Slobin, 1973). More specifically, an inflectional system that makes use of a set of consistent and regular rules and that relies on suffixes instead of prefixes should be easier than other systems to acquire. The Ngas inflectional system is fairly regular. In this system of inflections, the form of a verb is unchanged across the different tenses/aspects/persons, while the tone and length of a separate person–aspect marker changes. For

example, a separate morpheme *nga* is used with a main verb (e.g. *met* 'go') to signal person and aspect (e.g. *nga met* 'I will go'). The phrase *nga met* with *nga* produced with a falling tone and longer vowel can be translated as 'I have gone'; *nga met* with *nga* produced with a mid tone and short vowel translates as 'I went,'; and *nga met* with *nga* produced with a high tone and short vowel as 'I will go'. One implication this may have for verb learning is that children hear the main verb in a single form repeated across contexts. This repetition of the main verb may facilitate early stages of verb acquisition if it allows children to notice similar verb uses across these different contexts. Ngas is thus similar to other languages that also have minimal verb morphology (e.g. English) and different from highly inflected languages (e.g. Spanish, Italian). There is also some repetition in the nominal system of Ngas. Ngas does not have separate singular and plural noun forms, but typically marks the plural with a separate morpheme (*mwa*). For example, *mus* ('cat') becomes *mus mwa* ('cats'), *lu* ('hut') becomes *lu mwa* ('huts') and *gurm* (person) becomes *gurm mwa* (people). Again, repetition of the same form of the noun across utterances may help children link the repetition of a noun across different sentence contexts.

An additional linguistic property that could help children acquire the words of their language is the presence of monosyllabic words. The presence of many monosyllabic words could make the word segmentation task more straightforward. Verbs in Ngas are uniformly monosyllabic, and some Ngas nouns are disyllabic. Verbs in particular should be easier to acquire in Ngas than in other languages with multisyllabic verbs (e.g. Spanish, Italian).

An examination of these linguistic properties of Ngas suggests that verbs in this language may not be as disadvantaged as they are in some other languages. The inflectional system is regular, there is repetition of the main verb and all of the verbs are monosyllabic. Ngas is similar in some ways to Mandarin Chinese in that both have monosyllabic verbs that are repeated (Tardif *et al.*, 1997), but is different from Mandarin in that Ngas has an inflected person–aspect marker as well. Given the linguistic similarities Ngas shares with Mandarin, and the finding that young Mandarin-speaking children do not appear to have a noun bias (Tardif *et al.*, 1997), Ngas children could show less of a noun bias than is seen in other languages (e.g. English, Italian).

One focus of the study was to examine the children's joint attention skills in a traditional culture. A second goal was to examine early word learning in a language that has some linguistic properties that favor verbs. A third goal was to examine how these fit together by investigating whether joint attention is related to noun and verb learning in the second and third years.

METHOD

Participants

Eight younger toddlers (1;0–1;5, *M* age = 1;2) and eight older toddlers (1;7–2;7, *M* age = 2;1), with an approximately equal number of boys and girls in each group (five boys in the younger group, three in the older group), participated in the study. Three of the children had no siblings; thirteen had at least one older sibling (*M* = 2; range = 1–6 siblings). All of the children were recruited in a single rural village, Tuwan, approximately 90 miles southeast of Jos in Plateau State in south-central Nigeria. A Ngas-speaking research assistant from the village verbally explained the research project to one of the parents in the family. After this explanation, the parent was given an opportunity to ask questions and then asked to provide written consent for the child to participate. No parents refused to participate in the study. These children heard Ngas on a daily basis and also would have had some limited exposure to a regional language used for trade (Hausa) spoken throughout northern Nigeria.

We asked parents to describe who the primary caregivers were for each child during the day. Over half of the sample stayed with grandparents during the day (9 of 16). Other children stayed with their mother (4) or father (1). Four families reported some or most of the caregiving was provided by an older (11–14) child. Parents also reported that their children's first words were produced at 10 months (*M* = 0;10.6; range: 0;8–1;0). In comparison, children began walking after their first birthday (*M* = 1;1.1; range: 0;9–1;6), perhaps because they are often carried on caregivers' backs. No parent reported illness, prematurity or other extreme complication at birth.

Materials

Naturalistic observations and structured joint attention tasks. A portable video camera was used to record social interactions. A set of toys from the USA included an African-American doll, a dog with wheels, a stacking ring toy, two stuffed animals (a killer whale and a pig), a small car, a plastic elephant and a ball. Each child was offered a few objects (2–3) from this set during his/her observation session. There were also two wind-up toys for the structured joint attention tasks, a purple dinosaur and a red crab. One advantage of using these toys was that it allowed these Nigerian children to be engaged with objects that are similar to those that are played with by children in joint attention studies in Western cultures. A disadvantage was that these toys were not from their culture. Some toys would have been available to these children (plastic balls, dolls), thus they would have been familiar with playing with toys in some way. After the initial sample of interactions was collected, the

toys were left in the village so were potentially available at subsequent tapings.

Parental checklist. A linguist who lived with the Ngas people for approximately five years, analyzed the phonology and grammar of Ngas (e.g. Burquest, 1973), is a fluent speaker of Ngas and has extensive experience in translating texts from various languages into Ngas, helped to create a Ngas version of the *MacArthur-Bates Communicative Development Inventory: Words and Gestures* (Fenson, Dale, Reznick, Bates, Thal & Pethick, 1994). The inventory was evaluated by a Ngas research assistant to be sure the items asked about would be relevant to the Ngas culture. As noted by the MacArthur-Bates CDI Advisory Board, a new inventory is always an adaptation of the CDI and not a translation because there are often many differences between languages and cultures that impact specific categories on the list (e.g. clothing, food, household objects). The adaptation of the English CDI into Ngas was relatively straightforward in the sense that there were many single Ngas words that fit the same or similar concepts as referred to by the English words. After administering the inventory once, a few changes were made to the list before the second administration; the major change in the inventory between the two time points was an increase in the number of verbs included on the list.

At Time 1, the checklist included four categories of nouns including animals (28 words), food and drink (32 words), body parts (30 words) and people (21 words), and a list of verbs (33 words). Of the 111 nouns, almost half of the words in Ngas (51) were words that referred to the same objects as on the English version of the CDI, 15 additional words in Ngas were related to the English words on the CDI (for example 'locust' for *bug* and 'guinea fowl' for *turkey*) and the remaining 45 words were words our Ngas speaker and Ngas research assistant recommended as good candidates for words Ngas toddlers could understand or say. For example, in the animal category, 15 of the Ngas words were the same as words on the English list, 4 words were related to English words, 9 new words were added and 7 words on the English CDI were excluded. In thinking about this category in particular, given that there were few replicas of animals that toddlers had access to as toys, and no books with animal pictures (to our knowledge), we removed the names of animals these children would not have seen (e.g. 'giraffe') and added animals the children could have encountered as living beings (e.g. 'goat', 'chameleon', 'caterpillar', 'lizard', 'cricket'). One reason the body parts and people categories were included on our inventory was that these categories allowed us to use many words in Ngas that could be translated as English words that appeared on the English list. The food and drink category was more similar to the animal category in that we needed to consider foods and drinks relevant to this culture. However, even

in this category, we were able to preserve 14 of 31 of the words on the original list.

The adaptation of the verb category also was not difficult. At Time 1, we asked about 33 verbs, 13 of those verbs were equivalent to verbs on the English CDI, 5 were related verbs (e.g. 'hit (once)' and 'hit (many times)' for *hit*, 'break (like a stick)' and 'break (like a pot)' for *break*), and 15 were new verbs; these new verbs were all equivalent to verbs listed on the English CDI: Words and Sentences form. The major change between the administration of the list between Time 1 and 2 was that the newer list included many more verbs (79 words) than had the first list. Of these verbs, 40 had clear counterparts in English and appear on the English CDI, 8 were closely related to English verbs (e.g. 'like/love' instead of *love*; 'speak' instead of *say*), and 31 were new words, all of which fit English verbs asked about on the Words and Sentences form of the English CDI.

As in the original checklist, the Ngas version included three initial questions to ascertain whether children are beginning to indicate that they are understanding language, a section of simple phrases (e.g. 'Are you hungry?'), two questions about imitation and spontaneous naming and then several sections from the vocabulary checklist including nouns and verbs. Because parents uniformly reported that their children were ready to understand language, understood all simple phrases and were imitating and spontaneously naming objects, these questions were dropped from the list at Time 2. At the end of the checklist, as in the original form, we asked about five different communicative gestures (pointing, giving, pick up, give me/come, and any other gesture with the body) and asked six questions about children's pretend play. Children's pretend play abilities may reflect their ability to think symbolically, which is related to language development (e.g. McCune-Nicolich, 1981).

Procedure

Upon meeting the parent(s) at their compound and obtaining informed consent, we then asked them to interact with their child in any way they wished for approximately 15 minutes while we videotaped their interaction. Many studies of joint attention have included similar amounts of time (e.g. Tomasello & Farrar, 1986).

Typically, in Western homes, caregiver–child dyads would be relatively isolated from other people because they live in single family homes. Because this is not characteristic of village life, our interactions often included dyads within a complex social scene that incorporated other people. However, we were careful in our implementation of the study to be sure that in no case was a child and caregiver simply 'on display' surrounded by onlookers. The situation also did not include any activity (e.g. cooking, farming) other

than social interaction. The video camera was positioned on a tripod to capture the behavior of the target child and the other person he/she was interacting with at the time. The camera was moved as needed to follow the child's activities, keeping him/her in view.

In most of these naturalistic observations, additional adults (other than the parent/caregiver and experimenter) and peers were present. Additional adults who were present were typically not interacting with the target child but were mostly interacting with each other. In almost all of the interactions, the target child could interact with one or more additional children as well as their caregiver.

Following the naturalistic observations, we presented a series of four short structured tasks modeled after those described in Carpenter *et al.* (1998). Before beginning the administration of these tasks, the experimenter moved the target child away from any other children who were present. The tasks thus included the experimenter, the parent or caregiver and the child. At times other children were in view, but they did not interact with the target child. Given that children in this culture are often surrounded by other children and adults, we did not think the presence of other children who did not interact with the target child was overly distracting.

Two tasks were used to elicit communicative gestures from the child. In a blocking task (Phillips, Baron-Cohen & Rutter, 1992 cited in Carpenter *et al.*, 1998), an adult gave the child a new object, waited until the child attended to the toy and then covered it with her hands (half of the time this task was performed by the caregiver). In the other task, an adult presented a wind-up toy, wound it up and pushed it towards the child (usually performed by the experimenter). Caregivers were included partly because our research assistant thought that the children would be most comfortable in responding to their parents. The experimenter was present and directed the tasks at all times. For these tasks, the camera was positioned mainly in front of the child's face with the size of the view set in a way that still captured the actions of the adult. The order of these two tasks was varied. TQ1

We also performed two tasks to examine children's interpretation of communicative gestures. In a short point-following, task the Ngas research assistant or caregiver pointed in two to four different directions. The adult was positioned in front of the child and tried to establish eye contact with the child before beginning. Most points required prominent head turns. The camera was positioned to provide a profile view of the adult and child. We also attempted a gaze-following task but, given our filming conditions, we were unable to examine these responses further.

The Ngas research assistant administered the Ngas parental checklist. She presented each section orally to the parent and asked him/her to report whether the child understood or said each word. After the initial data

collection episode, the assistant returned six months later and repeated the naturalistic observation and parental checklist measures with the same families.

Coding

Naturalistic observations. Bakeman & Adamson (1984) defined six distinct, mutually exclusive categories of joint attention behaviors. These categories are: UNENGAGED, in which the infant is uninvolved with specific people, objects or activities; ONLOOKING, in which the infant is observing another's activity but is not taking part; PERSONS, in which the infant is interacting with the other person without including specific objects (e.g. in face-to-face play); OBJECTS, in which the infant is involved in playing with objects by him/herself and attending only to the objects themselves; PASSIVE JOINT ATTENTION, in which the infant and the other person are actively engaged with the same object but the infant does not appear to acknowledge the other person; and COORDINATED JOINT ATTENTION, in which the infant is actively involved with and coordinating attention to both the other person and the object of that person's focus. Coding categories are assigned based on whether children show a consistent type of behavior for at least three seconds.

We collapsed these six categories into three pairs of related states. These pairs are methodologically reasonable because they represent a 'low' level of joint attention (unengaged/onlooking), an intermediate ability (objects/persons) and a relatively sophisticated level of joint attention behavior (passive/coordinated joint attention). We are not the first to simplify Bakeman & Adamson's categories. For example, Carpenter *et al*. (1998) used only the highest level of joint attention, coordinated joint attention, in their analyses. We coded any joint attention behavior exhibited by the infant with any person in the interaction.

A single coder coded all of the interactions for the number of occurrences of each 3-second state. A second coder coded 20% of the participants for Time 1 and 25% of the participants for Time 2. There was 77% agreement between coders for Time 1 (Cohen's kappa = 0·64) and 76% agreement (Cohen's kappa = 0·53) between coders for Time 2.[1]

Measures of communicative gestures and structured joint attention tasks. Carpenter *et al*. (1998) showed a link between communicative gestures and referential language between 0;9 and 1;3. We asked parents to report their child's use of particular gestures on the checklist. We then

[1] According to Landis and Koch (1977), Cohen's kappa values of 0·61–0·80 reflect 'substantial' agreement, while values of 0·41–0·60 reflect 'moderate' agreement.

examined parents' report of the use of each gesture, combining their report of gestures used either 'from time to time' or 'all of the time'.

In addition, two structured tasks were used to elicit one or more communicative gestures from the child at Time 1 (due to an experimenter error, only half of the younger age received these two tasks). After the experimenter introduced the wind-up toy, we coded whether the child performed any gesture that would communicate some interest in interacting with the toy and the experimenter using four categories of communicative gestures. These categories were: SHOWING, in which the infant lifts his/her hand up with the object to display the object for the other person; GIVING, in which the infant extends his/her hand with the object to transfer possession of the object to the other person; POINTING, in which the infant points to a another person or object; and REACHING, in which the infant performs a reaching gesture to communicate interest in an object or person to another person. We also coded whether the child exhibited CHECKING behavior or looks to the experimenter's or caregiver's face. In addition, we categorized the child's overall response to the task in terms of the three joint attention categories used in the naturalistic observations. This coding procedure was repeated for the blocking task.

The point-following task examined their ability to respond to a communicative gesture. Children received two to four trials in which an adult pointed in different directions. We coded whether children looked in the direction of the point or did not. We also coded whether the child looked at the research assistant's face for further information or did not (demonstrated CHECKING). Children's responses across the pointing trials were combined to form an overall 'pass' (turn in direction of point 50% of the time or more) or 'fail' measure.

Interrater agreement for the coding of the two structured tasks and for the point-following task (with 20% of participants coded by a second coder) was 74% (Cohen's kappa = 0·69).

Receptive and expressive language. Parents reported whether their child comprehended or produced specific nouns and verbs, and these were tabulated for analysis. At Time 2 (six months later), we assumed all words reported at a previous time point were still comprehended or produced at the subsequent time point and simply added any new words that were reported.

RESULTS

Joint attention

We examined the proportion of time children engaged in joint attention during naturalistic observations recorded at an initial time period and six

TABLE 1. *Mean proportion of time (S.D.) spent in each category of joint attention*

	Time 1		Time 2	
	age group		age group	
Joint attention behavior	younger	older	younger	older
unengaged/onlooking	0·25 (0·18)	0·36 (0·16)	0·18 (0·11)	0·24 (0·25)
persons/objects	0·29 (0·18)	0·14 (0·11)	0·14 (0·11)	0·27 (0·17)
passive/coordinated	0·45 (0·18)	0·46 (0·10)	0·64 (0·16)	0·44 (0·29)

months later. Proportions were used to allow other researchers to easily compare these results to those available in other cultures, even if interactions in other studies are shorter or longer than 15 minutes. We examined three different levels of joint attention behavior: unengaged/onlooking, persons/objects and passive/coordinated joint attention.[2]

To examine the proportion of time children engaged in joint attention, we computed a repeated measures ANOVA with time (2: Time 1, Time 2) and joint attention behavior (3: unengaged/onlooking; persons/objects; passive joint/coordinated joint) as within subjects factors and age group (2: younger, older) as a between subjects factor.[3] The analysis revealed a main effect of joint attention behavior ($F(2, 10) = 11{\cdot}65$, $p < 0{\cdot}001$); time and age group were not significant, nor did either interact with any other factor (see Table 1). Pairwise comparisons with Bonferroni corrections showed that both the least complex ($M = 0{\cdot}26$, $S.D. = 0{\cdot}15$) and the mid-level joint attention behaviors ($M = 0{\cdot}20$, $S.D. = 0{\cdot}08$) were significantly less frequent ($p < 0{\cdot}05$ and $p = 0{\cdot}001$ respectively) than was the most complex joint attention behavior ($M = 0{\cdot}50$, $S.D. = 0{\cdot}16$).

A comparison of the proportions observed at Time 1 with the proportions observed in an English-speaking sample in the USA (Bakeman & Adamson, 1984) is presented in Table 2.

[2] Given that proportional data can be influenced by instability of error term variances, we computed analyses of the proportional data following arc-sine transformations (Neter, Wasserman & Kutner, 1985). The arc-sine transformational data analyses were not significantly different from the proportional analyses, thus the proportional analyses are reported.

[3] One older child refused to participate in the naturalistic observation session at Time 1, and three younger children did not participate in the naturalistic observation session at Time 2. All of these families completed the parental checklist measures except for the family of one of the younger children who had left the village between Time 1 and 2.

TABLE 2. *Percentage of time spent in each level of joint attention (Time 1) compared to percentages reported by Bakeman & Adamson (1984)*

	Group	
Joint attention behavior	Nigeria	USA (Bakeman & Adamson, 1984)
unengaged	8·8	6·1
onlooking	16·5	14·0
persons	4·5	4·6
objects	24·3	40·7
passive joint	18·8	23·1
coordinated joint	25·9	11·2

Our proportions were multiplied by 100 to compute percentages. The mean age in the Nigeria sample (younger group) is 1;2 (range 1;0–1;5). The age from the longitudinal data reported in Bakeman & Adamson (1984) is 1;3. The condition reported from Bakeman & Adamson (1984) is the Mother condition.

Communicative gestures

Parental report. We asked parents to report whether their child produced any of 5 communicative gestures. At the younger age, parents reported the production of 3·5 different gestures at Time 1 (*S.D.* = 1·6). The most frequent gestures that these parents reported at Time 1 were the gestures 'give' (extending an object in the hand, 7 of 8 children) and 'pick up' (raising both hands up to the adult, 7 of 8). The least frequent gesture was a 'give me/come' gesture (opening and closing of the hand, 4 of 8). At Time 2, these parents reported use of 4·7 different gestures at Time 2 (*S.D.* = 0·8). A post-hoc paired t-test with Bonferroni correction comparing Time 1 with Time 2 was not significant. For the older age group, parents at both Time 1 and Time 2 reported the production of 4·75 different communicative gestures (Time 1: *S.D.* = 0·5; Time 2: *S.D.* = 0·7).

Structured tasks. We performed two structured tasks to elicit communicative gestures. In one task, we introduced a wind-up toy to the child because other studies had used such a toy to elicit communicative gestures (e.g. Carpenter *et al.*, 1998). This toy was not as useful in this culture because it frightened some children. Half of the children in each age group exhibited some communicative gestures, almost all of which were reaching gestures. One additional older child pointed to the object. Only one younger and one older child produced a checking behavior. Almost all of the children were engaged in one of the less complex joint attention behaviors (unengaged/onlooking, or persons/objects) during the task.

Children exhibited more of the more complex joint attention behaviors in the blocking task than were seen in the wind-up task. In this task, half of the

younger children and half of the older children performed a communicative gesture; all gestures were reaching gestures. Four of the younger children and one older child demonstrated checking with an adult. Many children (3 of 4 younger and 4 of 8 older) were engaged in the highest level of joint attention behaviors (passive or coordinated joint attention) during the task.

In addition to these tasks designed to elicit communicative gestures, we performed a short point-following task to examine children's ability to interpret a communicative gesture. Most of the children passed the point following task (3 of 4 younger and 7 of 8 older). Only one older child on one trial exhibited checking behavior.

Word comprehension and production

Children's language development was assessed using a parental checklist (i.e. the MCDI; Fenson *et al.*, 1994) adapted for this language and culture. In the following analyses, we examined children's ability to comprehend and produce nouns and verbs by examining the proportion of words reported in relation to the number of nouns or verbs on the list (or WORD OPPORTUNITY SCORE; Bornstein *et al.*, 2004). A consideration of the relative proportion of words is a more conservative measure of children's word learning, and is more appropriate for checklist measures, than is the absolute proportion of nouns and verbs (Pine, Lieven & Rowland, 1996; Bornstein *et al.*, 2004). In addition, studies that have reported word opportunity scores, absolute proportions and raw scores have found similar patterns (Bates *et al.*, 1994, cited in Bornstein *et al.*, 2004). Proportional data also allowed us to compare Time 1 to Time 2 even though we increased the number of verbs asked about at Time 2 (see footnote 2). TQ1

Proportion of words reported in relation to the number of words of that type on the list. A repeated measures ANOVA with time (2: Time 1, Time 2), word type (2: noun, verb) and task (2: comprehension, production) as within subjects factors, and age group (2: younger, older) as a between subjects factor was used to examine children's ability to comprehend and produce nouns and verbs. This analysis revealed a trend towards significance for time ($F(1, 13) = 3{\cdot}35$, $p < 0{\cdot}10$), a main effect of word type ($F(1, 13) = 32{\cdot}87$, $p < 0{\cdot}001$), a main effect of task ($F(1, 13) = 50{\cdot}05$, $p < 0{\cdot}001$) and a main effect of age group ($F(1, 13) = 18{\cdot}28$, $p = 0{\cdot}001$). There were also two 2-way interactions, word type by task ($F(1, 13) = 18{\cdot}56$, $p = 0{\cdot}001$) and word type by age group ($F(1, 13) = 6{\cdot}98$, $p = 0{\cdot}02$) (see Table 3).

Pairwise comparisons with Bonferroni corrections were used to examine each 2-way interaction. In terms of the word type by task interaction, parents reported more nouns and verbs as comprehended than they

TABLE 3. *Children's comprehension and production: proportion* (*S.D.*) *of words reported by each word type*

task	Time 1		Time 2	
	age group		age group	
word type	younger	older	younger	older
comprehension				
nouns	0·19 (0·13)	0·43 (0·12)	0·35 (0·07)	0·51 (0·08)
verbs	0·33 (0·24)	0·81 (0·15)	0·51 (0·19)	0·79 (0·14)
production				
nouns	0·07 (0·08)	0·35 (0·16)	0·17 (0·14)	0·43 (0·14)
verbs	0·08 (0·15)	0·46 (0·49)	0·16 (0·16)	0·46 (0·28)

reported in production. In comprehension, parents reported proportionally more verbs than nouns ($p < 0{\cdot}001$); there was no difference in the proportion of nouns and verbs reported in production. In the analyses of the word type by age group interaction, parents reported both more nouns and more verbs in the older group than the younger one (ps = 0·001). In the younger group, they tended to report proportionally more verbs than nouns ($p < 0{\cdot}06$), and in the older age group, this pattern was significant ($p < 0{\cdot}001$).

Children's symbolic ability (*pretend play*)

At the end of the vocabulary checklist, we asked parents about six different pretend play behaviors their children may have exhibited. These questions were included because pretend play may reflect a symbolic ability that is also useful in language development. At Time 1, parents of the younger-aged children reported approximately half of the pretend play behaviors we asked about ($M = 2{\cdot}75$, *S.D.* = 2·25). Parents of the older children reported almost all the behaviors ($M = 4{\cdot}75$, *S.D.* = 1·26).

The number of overall pretend play behaviors reported at Time 2 were, for the younger age ($n = 6$), $M = 3{\cdot}33$, *S.D.* = 2·73, and for the older age ($n = 7$), $M = 5{\cdot}0$, *S.D.* = 0·82. The patterns of the behaviors were similar across the two time periods.

Joint attention and language

Our final set of analyses were designed to examine whether the amount of time dyads were engaged in any of the three levels of joint attention could be related to the child's comprehension or production of nouns and verbs

(see Appendix). The analyses modeled only developmental periods during which there was a sufficient size of the dependent variable to expect a relationship between joint attention and either nouns or verbs. Specifically, we examined the influence of joint attention on noun comprehension and production after 1;4, because before 1;4 it is likely some children would be comprehending or producing a trivial number of nouns. We examined joint attention and verb comprehension and production after 1;8, an age after which children should have a reasonable number of verbs in comprehension and production. Thus, in these analyses, only one observation (Time 2) was entered into the model for children who were younger than these ages at Time 1 (four children in the noun analyses and seven in the verb analyses).[4]

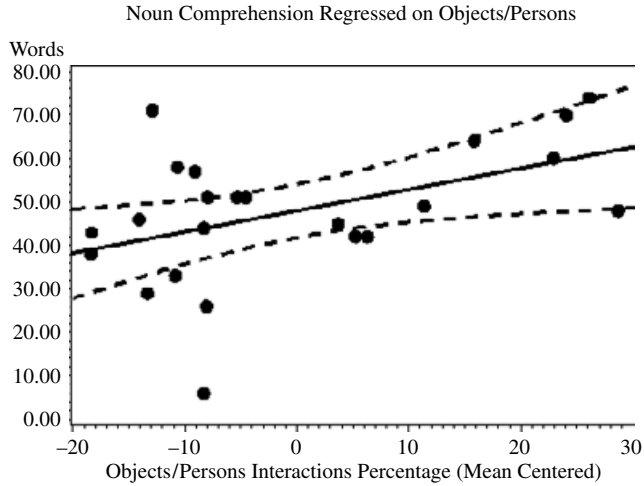
Correlation matrices were used to provide a preliminary examination of the relationship of each of the three levels of joint attention and language. These matrices suggested that the best predictor of language abilities was the second level of joint attention, objects/persons interactions, which was then pursued statistically in the model analyses. To conduct the analyses, the values of the objects/persons interaction proportions were multiplied by 100 and mean centered. As a result of mean centering, values below the mean are negative and above the mean are positive. The transformation of the objects/persons interaction proportions has no effect on the probability values in the significance tests performed.

These analyses revealed that the total amount of time spent in objects/persons interactions was a significant predictor of both noun comprehension ($t(1,7)=2{\cdot}69$, $p<0{\cdot}05$) and noun production ($t(1,7)=2{\cdot}57$, $p<0{\cdot}05$). Objects/persons interactions were also a significant predictor of verb comprehension ($t(1,6)=2{\cdot}69$, $p<0{\cdot}05$) and verb production ($t(1,6)=2{\cdot}54$, $p<0{\cdot}05$) (see Figures 1–4).

DISCUSSION

This study examines the joint attention behaviors of toddlers and their caregivers in the Ngas culture and investigates whether these behaviors may be linked to the acquisition of nouns and verbs. There were several reasons to predict that joint attentional behaviors may differ in this culture as compared to others, including the practice of carrying infants on caregivers' backs. Our analyses suggest that despite apparent cultural differences, these children's joint attention behaviors resemble patterns seen in other cultures. Specifically, the proportions of each joint attention behavior appear similar

[4] Analyses in which data was entered for each child only if the number of words reported met a specific minimum score revealed similar results (minimum scores used were 18 words for noun comprehension, 4 for noun production, 5 for verb comprehension and 0 for verb production).



Negative objects/persons interactions percentages represent total interaction times that are below the mean. Dotted lines demonstrate the 95% confidence interval around the regression line.

Fig. 1. Noun comprehension regressed on objects/persons.

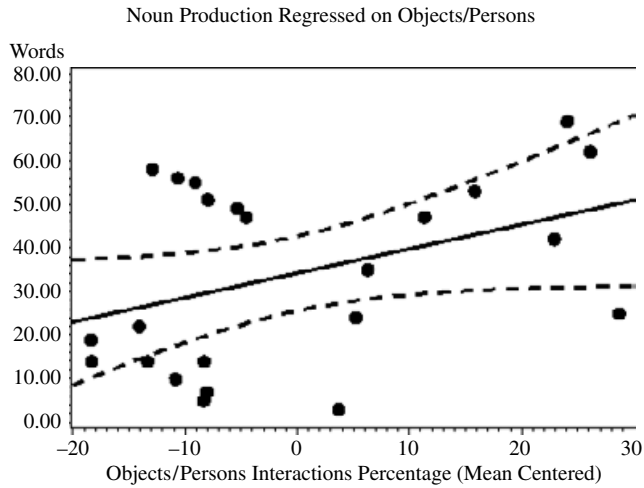


Fig. 2. Noun production regressed on objects/persons.

to those reported for a group of English-speaking toddlers in the USA (Bakeman & Adamson, 1984). Our data show that early in the second year, these toddlers are already producing more of the most complex attentional behaviors (passive/coordinated joint attention) than they are producing

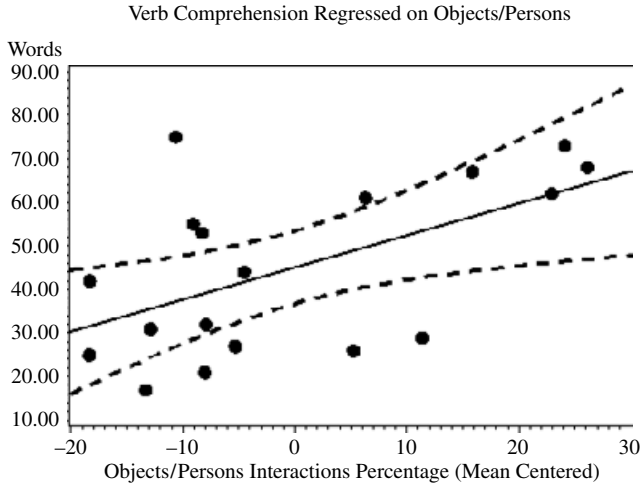


Fig. 3. Verb comprehension regressed on objects/persons.

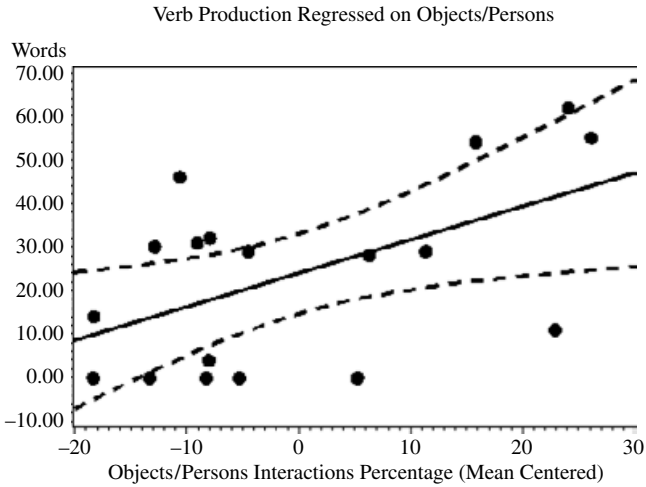


Fig. 4. Verb production regressed on objects/persons.

other less complex joint attention behaviors (e.g. unengaged/onlooking). In addition, these findings are confirmed in two behavioral samples collected six months apart. Future studies that examine the early development of patterns of interaction between caretakers and infants in more traditional cultures will be useful for understanding how joint attention behaviors

initially emerge. However, the present results contribute to the joint attention literature by suggesting that early in the second year, toddlers' joint attention skill in this traditional culture does not clearly differ from toddlers' skill in less traditional cultures.

A second goal of the study was to examine the patterning of noun and verb comprehension and production in this language group. This question is important in itself because Ngas shares some linguistic properties with other languages in which a 'noun bias' has not been found (e.g. Mandarin Chinese). Specifically, children hear a single verb form repeated across varying sentence types, and most of the verbs in Ngas are monosyllabic. These properties are similar to those of Mandarin Chinese. However, Ngas differs from Mandarin in that it has a regular inflectional system in which a person–aspect marker that is separate from the verb varies in different sentence contexts. Thus, the ability to drop the subject in Ngas is likely not as useful as in Mandarin because sentences in which the subject is dropped do not result in verb-initial utterances. In sum, there are two linguistic properties of Ngas that should aid in the acquisition of verbs and one that is not as advantageous.

To examine whether the pattern of these children's language development reflects a 'noun bias' or does not, we relied on the results of a parental report measure. Although parental reports provide only an estimate of language development, they are not as tied to specific objects or situations that may influence the words sampled in naturalistic contexts (Tomasello & Mervis, 1994). Pine *et al.* (1996) have shown that there is a moderate correlation between the number of nouns reported on a parental checklist and the number observed in a naturalistic interaction (i.e. correlations = 0·56 at 50 words and 0·64 at 100 words). They argue that a sample based on observation is more unreliable than is a checklist for estimating total vocabulary size because fewer nouns will appear in the observation than are available for report on the list. This assertion is supported by Tardif *et al.* (1999) who found that children produced only 10–15% of their reported vocabulary during an observation session. Given these previous studies, the use of a checklist in this study is not in itself problematic, especially if future studies add observational or diary methods.

Our analyses of children's vocabularies showed that when nouns differed from verbs, parents reported more verbs (in relation to the number of verbs on the list) than they reported nouns (of the number of nouns on the list). Specifically, parents reported more verbs than nouns in comprehension. In addition, the relative proportion of nouns and verbs reported for the younger age group tended to favor verbs, while the relative proportions in the older age group clearly favored verbs. These results are important to consider because most checklists (including this one) simply ask

parents about more nouns than verbs, so any noun bias may merely stem from the greater number of nouns than verbs that are included on specific lists.

Our finding that Ngas parents report that their children are learning more verbs than nouns (in relation to the number of each word type on the list) could result from both linguistic properties and cultural practices. Some linguistic properties of Ngas verbs (e.g. they are repeated, monosyllabic and do not change in form) should support verb learning, while the fact that it is possible to drop the subject is not as useful in Ngas for increasing verb saliency because an initial person–aspect marker remains. In terms of Ngas culture, children who are carried by a caregiver as she conducts her daily activities have the opportunity to be engaged in a rich social context that should be less focused on the naming of objects. In addition, children appear to receive many commands to direct their behavior that could favor verbs. These results are important because to date the only studies that have not shown a strong noun bias have included children in Asia learning Mandarin Chinese or Korean (e.g. Tardif *et al.*, 1997) and thus this study is the first to highlight other cultural contexts that may support verb learning. In addition, because Ngas shares two linguistic features with Mandarin but does not share a third (the usefulness of dropped subject sentences), these results show the relative contribution of these shared linguistic features on their own. The question of how cognition, language and culture contribute to noun and verb learning is important for understanding the mechanisms that support the learning of particular word types. Our results suggest that cultural practices in a child's daily life and specific linguistic properties of nouns and verbs play an important role in early vocabulary development.

Importantly, an influence of cultural practices in language development is also supported in our final set of statistical analyses. These analyses specifically examine a particular behavior in a culture, the support of joint attention, and the development of the comprehension and production of specific word types. Previous studies have shown a general relationship between behaviors produced by caregivers that facilitate joint attention (e.g. following in to children's utterances) and children's subsequent language development (e.g. Tomasello & Todd, 1983). Studies have demonstrated a relationship between infants' ability to respond to an adult's joint attention behaviors (i.e. follow an adult's gaze or points) and receptive or productive abilities later in development (Mundy & Gomes, 1998). Studies have also suggested a link between the infant's own production of joint attention behaviors and language (e.g. Harris *et al.*, 1995; Mundy & Gomes, 1998; Carpenter *et al.*, 1998).

Our analyses reveal a link between the proportion of time dyads spent in joint attention behaviors at a middle level of complexity (persons/objects)

and word learning. In our sample, there was less variability in the amount of time children were engaged in the lowest and highest types of joint attention behaviors than there was in this mid-level behavior. In addition, variability at this middle level of joint attention was a better predictor of variability in word learning than was variability at other levels. Specifically, children who experienced more of this mid-level behavior as compared to less of it were also reported to be learning more words.

It is still possible that joint attention behaviors at all three levels, or at the mid level and highest level, contribute to language development. In our sample, children demonstrated relatively high proportions of the highest level, with this level making up almost half of the time in their interactions at Time 1 and more than half of the time of interactions at Time 2. Dyads varied in the proportion of the time that they engaged in mid-level behaviors and this variation was a good predictor of language development. Because most previous studies linking joint attention and language have either used very specific categories of joint attention behaviors (e.g. gaze following, Mundy & Gomes, 1998) or have examined only the highest level of behaviors (e.g. coordinated joint attention, Carpenter *et al.*, 1998), further studies are needed to explore whether this result may generalize more broadly.

Additionally, our study is one of the few studies that have considered noun and verb development separately, and it did not reveal differences in the relationship between joint attention behavior and nouns as compared to verbs. However, because of differences in the overall number of nouns and verbs comprehended and produced, the model needed to be applied to verb comprehension and production at a later developmental period than was used for nouns. It is important to note that our coding schemes did not capture precise moments in time in which verbs were uttered during the joint attention episode. Thus, Tomasello & Kruger's (1992) study showing that children learn verbs best in impending and completed contexts still provides the most detailed analysis of joint attention and verb learning. However, our results provide additional evidence that joint attention behaviors are linked to verb learning. Tomasello & Kruger speculated that children may use an adult's attention to an object to guide their inferences about the adult's intentions, which may aid in verb learning. Further studies of joint attention and verb learning could explicitly test this idea or more specifically examine how joint attention behaviors contribute to verb learning.

Studies that examine the interrelations between abilities in different domains are important. Children are developing in multiple ways at the same time, and development within a specific domain may have an influence beyond that particular domain. Given the difficulty of learning a first language, it is not particularly surprising to reveal children's use of any

information available, particularly information that could directly inform them about the parent's communicative intentions. In fact, it would almost be more surprising if social interaction and language were not linked in some way. Our study suggests that these abilities are linked in the second year in an interesting cultural and linguistic group.

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APPENDIX

We used a multilevel modeling approach (hierarchical linear model or mixed model) to test this question because this type of analysis takes into account the nested structure of our data (i.e. each time point is nested within individuals) and allows for incomplete data at any measurement point (Raudenbush & Bryk, 2002). The allowance of incomplete data is important in this study because there were occasions in which the data were not available, and occasions (time points) which were not appropriate to enter into the analysis because the dependent measure was too small (i.e. the number of words comprehended or produced was too trivial to be considered as a dependent measure in the model). The multilevel random intercept model uses a maximum likelihood estimation to allow all valid measurement time points to be used without excluding participants who are missing one of the two measurements (e.g. vocabulary at Time 1 or at Time 2). A more common regression analysis requires independence of observations and is not appropriate for these data which include multiple time points for each individual. Random intercepts models avoid the requirement of independence of observations because individual participants are treated as a random effect and there is thus two error terms: one error term represents the within participant variation while the other is the between participant variation.

The transformation of the objects/persons interaction proportions increases the interpretability of the model parameters: the model's intercept values represent the mean value of the dependent variable at the mean of the independent variable and the slope represents the number of units increase in the number of words comprehended or produced for each percent of the total time that participants were engaged in objects/persons interactions. Residual by observed values were plotted to examine the assumption that residual variance was randomly distributed. There were no obvious patterns in the plots to suggest a curvilinear or other non-linear pattern.