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The Organization of Words and Symbolic Gestures in 18-Month-Olds' Lexicons: Evidence From a Disambiguation Task

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Infants' early communicative repertoires include both words and symbolic gestures. The current study examined the extent to which infants organize words and gestures in a single unified lexicon. As a window into lexical organization, eighteen-month-olds' (N = 32) avoidance of word–gesture overlap was examined and compared with avoidance of word–word overlap. The current study revealed that when presented with novel words, infants avoided lexical overlap, mapping novel words onto novel objects. In contrast, when presented with novel gestures, infants sought overlap, mapping novel gestures onto familiar objects. The results suggest that infants do not treat words and gestures as equivalent lexical items and that during a period of development when word and symbolic gesture processing share many similarities, important differences also exist between these two symbolic forms.

In the early stages of language development, infants' symbolic repertoires include both words and symbolic gestures. A wealth of research has revealed many commonalities between these two symbol types. Observational research, case studies and diary reports have revealed that words and symbolic gestures share a similar age of onset (Capirci, Montanari, & Volterra, 1998; Goodwyn & Acredolo, 1998; Shore, Bates, Bretherton, Beeghly, &

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O'Connell, 1994), serve similar communicative functions (Acredolo & Goodwyn, 1988; Caselli, 1994; Iverson, Capirci, & Caselli, 1994) and are used complimentarily to denote mutually exclusive referents (Acredolo & Goodwyn, 1988; Caselli, 1994; Iverson et al., 1994; Shore et al., 1994). Additionally, controlled laboratory studies have demonstrated that typically developing hearing infants, between 14 and 18 months of age, learn both words and symbolic gestures as object category labels with equal facility (Namy, 2001; Namy, Campbell, & Tomasello, 2004; Namy & Waxman, 1998), use both words and symbolic gestures to guide inferences about hidden object properties (Graham & Kilbreath, 2007) and process the semantics of both words and symbolic gestures through similar neural channels (Sheehan, Namy, & Mills, 2007).

Although there is little doubt that infants' use, processing and acquisition of words and symbolic gestures are tightly linked, the precise nature of the relation between the two symbol types is not well understood. Based on the evidence, many gesture scholars (e.g., Acredolo, Goodwyn, Horobin, & Emmons, 1999; Caselli, 1994; Clark, 2003) have argued that words and symbolic gestures are equipotential and comparable components of the infant's early developing lexicon. Clark, for example, has suggested that, "gestures and words form a single lexicon" (Clark, 2003; p. 96). Caselli has similarly proposed that, "there is one lexicon constructed partially from gestures and partially from words" (Caselli, 1994; p. 65). Namy, Acredolo, and Goodwyn (2000) have also argued for an "…equipotentiality with which children acquire and interpret verbal and gestural symbols early in development" (p. 67). According to this view then, the relation between words and gestures early in development is akin to how some have hypothesized that bilingual children initially store and organize words of the two languages in a single undifferentiated lexicon (e.g., Prinz & Prinz, 1981; Volterra & Taeschner, 1978; but see Pearson, Fernandez, & Oller, 1995; Quay, 1995).

Consistent with this view, infants' words and gestures appear to be mutually exclusive (Acredolo & Goodwyn, 1988; Caselli, 1994; Iverson et al., 1994; Shore et al., 1994). That is, in the early stages of communicative development, 12- to 16-month-old infants rarely use both a word and a symbolic gesture for the same referent. Once they do acquire a verbal label for an object for which they previously acquired a gestural label, the gestural label drops out of their vocabulary (Acredolo & Goodwyn, 1988; Caselli, 1994; Iverson et al., 1994; Shore et al., 1994). This certainly suggests that words and symbolic gestures serve complimentary rather than augmentative roles in infants' early communicative repertoire. The goal of the current study is to investigate the mutual exclusivity of words and symbolic gestures

experimentally as a window into whether young word learners store, organize and represent words and symbolic gestures in a single lexicon.

To examine this, we capitalize on young word learners' tendency to avoid lexical overlap (e.g., Graham, Poulin-Dubois, & Baker, 1998; Liittschwager & Markman, 1994; Mervis & Bertrand, 1994). One well-documented behavioural manifestation of this tendency, known as the *disambiguation effect*, is that when presented with two objects, one novel (e.g., a garlic press) and the other familiar (e.g., a spoon), young children avoid interpreting a novel word (e.g., "give me the *blicket*") as a second label for the familiar object. Instead, they link the novel word to the novel object. There is a rich debate over the precise mechanisms that underlie this behaviour. For example, whereas some suggest that it reflects an avoidance of lexical overlap (e.g., Markman & Wachtel, 1988; Markman, Wasow, & Hansen, 2003), others suggest that it reflects a preference to attach a novel label onto a nameless object (Golinkoff, Mervis, & Hirsh-Pasek, 1994) or a predisposition to fill lexical gaps (e.g., Merriman & Bowman, 1989). Regardless of the precise process that underlies the disambiguation effect, the phenomenon itself provides a valuable opportunity to investigate the relationship between words and gestures in the developing lexicon by comparing avoidance of overlap *within* the verbal modality versus avoidance of overlap *between* the verbal and gestural modalities.

We propose that if words and gestures reside in a single lexicon and have the same referential and representational status, then when presented with a disambiguation task in which the novel label is a gesture, infants should select the novel object and avoid the familiar object just as they do when the label is a novel word. Alternatively, if infants do not treat words and gestures as part of a unified lexicon with equal lexical status, then infants will not necessarily avoid applying a gestural label to the familiar object.

In the current study, we presented 18-month-olds with a standard disambiguation task (Markman & Wachtel, 1988). We chose 18-month-olds as our target population because previous work has demonstrated that infants at this age spontaneously use and interpret words and symbolic gestures as names for objects (e.g., Namy, 2001; Namy & Waxman, 1998) and this is the earliest age at which infants demonstrate the disambiguation effect using overt choice measures (e.g., Graham et al., 1998; Mervis & Bertrand, 1994). In this task, the experimenter presented infants with a familiar object (for which infants had a verbal label) and a novel object (for which infants had no verbal label) and then produced a novel label and asked infants to select the object to which the label referred. The novel label was either a novel word (e.g., "blicket") or a novel gesture (e.g., a dropping motion). Of interest was the extent to which infants would be as inclined to avoid gesture–word overlap as they do word–word overlap.

METHOD

Participants

Thirty-two 18-month-olds (M = 18.4, range = 17.2–19.6, 16 female) from predominantly middle-class families participated. The sample was 67% White, 16% Black, 13% Asian and 2% Native Hawaiian/Other Pacific Islander. Parents completed the MacArthur-Bates Communicative Development Inventory Short Form (Fenson et al., 2000), which measures infants' productive vocabulary. We transformed raw scores into percentile rank scores, based on validated age and sex norms (see Fenson et al., 2000). Rank scores did not differ between infants in the word (M = 39.7, SD = 31.2) and gesture (M = 47.5, SD = 24.5) conditions, p = .44. An additional 11 participants' data were excluded from analysis because of the failure to complete at least eight of twelve trials (7) or displaying a side preference (4, see *coding*, *procedure* below).

Stimuli

Stimuli consisted of three pairs of small plastic toy replicas of objects including one novel and one familiar object. The three pairs were selected from four possible sets (see Table 1): *juicer—hammer, whisk—cup, garlic press—spoon and roller—keys*. Based on parental familiarity ratings, we selected the three pairs that maximized each infants' familiarity with the familiar object and unfamiliarity with the novel object.

Novel words were two-syllable strings that adhered to the phonotactic constraints of English. Novel gestures were patterned after the hand shapes and motion trajectories used in sign languages (see Table 2). For each participant, the novel label assigned to each object pair was randomly determined.

TABLE 1
Pairs of Novel and Familiar Objects Used (Mean Parental Familiarity Rating on a Four-Point Scale in Parentheses)

	Novel object	*Familiar object*
Pair 1	Juicer (1.07)	Hammer (1.97)
Pair 2	Whisk (1.20)	Cup (3.37)
Pair 3	Garlic Press (1.07)	Spoon (3.52)
Pair 4	Roller (1.10)	Keys (3.42)

Note. For all pairs, parents rated the familiar object as more familiar than the novel object, ps < .05. There were no differences in familiarity ratings across conditions, all ps > .10

TABLE 2
Novel Words and Novel Gestures Used

Novel word	*Novel gesture*
Blicket	Repeated simultaneous extension of index and middle finger from a closed fist
Daxen	Side-to-side motion, hand extended as if to shake hands
Seebow	Dropping motion with closed fist opening, palm down

Procedure

Infants were randomly assigned to either the word or gesture condition. The experimental procedure was identical in the two conditions, with the exception of the type of novel label employed by the experimenter. Infants completed four trials with each pair of objects including two target trials (in which the experimenter asked the infant to choose the referent of a novel label) and two preference control trials. Because there were three sets, infants completed a total of twelve trials, including six target and six control trials.

Infants either sat on a booster seat or on their parents' laps across a table from the experimenter. The experimental procedure included a familiarization phase followed by a test phase for each set of objects.

Familiarization phase

For each set, the experimenter presented the pair of objects simultaneously and encouraged infants to explore the two objects. The goal of the familiarization phase was to reduce the novelty of the novel object (Graham, Turner, & Henderson, 2005), thus reducing the likelihood of infants choosing the novel object due to an overall novelty preference (Horst, Samuelson, Kucker, & McMurray, 2011; Merriman & Schuster, 1991). The experimenter ensured that infants directed their attention to each object.[1] After approximately 30s, the experimenter removed the two objects from infants' reach.

Test phase

The test phase included two target trials and two control trials for each set. In the target trials, the experimenter asked infants to select one of the

[1]A coder, blind to condition, confirmed that the duration of interaction between the familiar and novel objects did not differ reliably in either the word ($M_{\text{familiar}} = 18.3$; $M_{\text{novel}} = 18.8$) or gesture condition ($M_{\text{familiar}} = 18.3$; $M_{\text{novel}} = 17.7$), all $ps > .10$.

objects using a novel label, either word or gesture, depending on the condition: saying, for example, "Which one can you get? Blicket/[Gesture]! Can you get it? Blicket/[Gesture]!" Following the second production of the label, the experimenter advanced the objects within the infants' reach, one on each side and equidistant from the infants' midline.[2] While eliciting the choice, the experimenter's gaze was directed at the infant's face. The labels were introduced in syntactic isolation to avoid syntactic cueing. On control trials, the experimenter elicited a choice by saying, "Which one can you get? Can you get one?" Infants were given neutral feedback (e.g., "Thank You") regardless of which object they chose. Trials were blocked by type, but order of presentation of target and control trials was consistent across sets for each infant and counterbalanced across infants. After completing the familiarization and test phases for the first set of objects, the procedure was repeated for the second and third sets.

Coding

A primary coder, blind to the experimental hypotheses, analysed videotapes of all infants with the sound muted. For each trial, infants' choices were characterized as choosing the novel object, the familiar object or neither. Infants were excluded from the analysis if (a) they made a clear choice on fewer than eight of the twelve trials (four of each trial type), or (b) they exhibited a side bias on all or all but one trial. The number of trials completed by infants in the final sample across the Word ($M = 11.6$, $SD = 1.0$) and Gesture ($M = 10.9$, $SD = 1.2$) conditions did not differ reliably, $p = .10$. A second coder, blind to the experimental hypotheses, coded a randomly selected 25% of sessions in each condition. Inter-coder agreement was 97%.

RESULTS

We calculated the proportion of target and control trials on which infants selected the novel object in each condition. We conducted a preliminary analysis to examine the extent to which infants in either condition altered their responses between the first and second target trial via a Condition

[2]Blind coding of proximity of each object to the child, derived from still frames of the moment the experimenter advanced the two objects, indicated that the proportion of trials in which the novel object was judged to be closer to the child was not different for either trial type, in either the word ($M_{target} = .53$, $M_{control} = .53$) or gesture ($M_{target} = .50$, $M_{control} = .52$) condition. Further, these proportions were not different from chance (.50), all $ps > .10$.

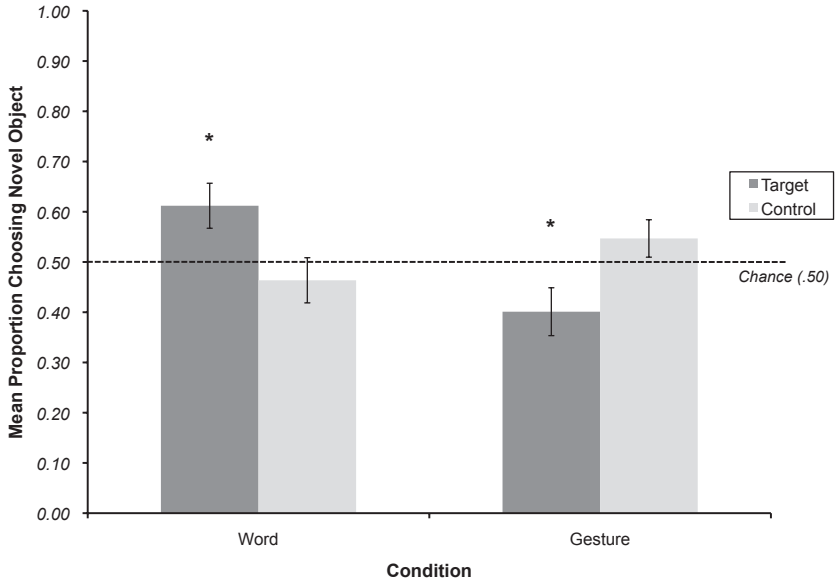

Figure 1 Mean proportion choosing novel object on target and control trials in each condition. Error bars indicate ± *SEM*; *different from chance at $p < .05$.

(Word versus Gesture) × Serial Position (first versus second trial) analysis of variance (ANOVA) on proportion choosing novel object on target trials. We found no significant main effects or interactions, *p*s > .10, suggesting that performance in both conditions was consistent across the first and second target trials. Thus for the analyses that follow, proportion data were collapsed across first and second trial responses. Avoidance of overlap was operationalized as a greater mean proportion of choosing the novel object on target than on control trials as well as selecting the novel object more often than predicted by chance (.50) on target trials.

A Condition (Word versus Gesture) × Trial Type (Target versus Control) analysis of variance (ANOVA) on proportion choosing novel objects yielded no main effects but a significant interaction between condition and trial type, $F(1, 30) = 14.22$, $p = .001$, $\eta_p^2 = .322$.[3] As shown in Figure 1, infants in the word condition selected the novel object on the target trials ($M = .61$, $SD = .04$) more than on the control trials ($M = .46$, $SD = .04$), $t(15) = 2.92$, $p = .01$ (all reported *t*-tests are two-tailed), thus exhibiting avoidance of lexical overlap. In contrast, infants in the gesture condition

[3]An analysis that included infants excluded because of less than criterion responding or side-bias, yielded a similar statistical interaction: $F(1, 41) = 9.44$, $p = .004$.

displayed the *opposite* pattern, selecting the novel object reliably *less* often on the target trials ($M = .40$, $SD = .04$) than on control trials ($M = .54$, $SD = .04$), $t(15) = -2.46$, $p = .03$.

Comparisons to chance revealed that infants in the word condition selected the novel object on target trials significantly more often than predicted by chance, $t(15) = 2.50$, $p = .02$, but responded randomly on control trials, $p = .81$. Conversely, infants in the gesture condition selected the novel object on target trials significantly *less* often than predicted by chance, $t(15) = -2.10$, $p = .05$. That is, they reliably mapped the novel gestures to the familiar objects. Their responses on control trials did not differ from chance, $p = .23$.

Individual infants' performance was highly consistent with the group-level data. Table 3 presents the number of infants in the word and gesture conditions who selected the novel object *more* often on target than control trials, *equally* often across the two trial types and *less* often on target than control trials. The distribution of individual response patterns differed reliably between the two conditions, $\chi^2 (1, N = 32) = 8.80$, $p = .01$.

Finally, we examined the extent to which infants' performance varied as a function of verbal vocabulary size. To test this, we calculated a difference score between proportion choosing the novel object on target trials versus control trials (hereafter Overlap Avoidance (OA) score, see also Byers-Heinlein & Werker, 2009; Halberda, 2003). A high positive OA score reflects avoidance of lexical overlap. For infants in the word condition, we found a positive correlation between productive vocabulary and OA score, $r = .57$; $p = .02$, This finding is consistent with previous work (Graham et al., 1998; Mervis & Bertrand, 1994) reporting that the strength of infants' adherence to lexical overlap avoidance increases as a function of vocabulary size. In contrast, for infants in the gesture condition, verbal productive vocabulary was not correlated with their OA scores, $r = .29$; $p = .26$.

DISCUSSION

In the current study, we investigated the extent to which young word learners treat words and symbolic gestures as common forms of reference, by

TABLE 3
Distribution of Individual Patterns of Behaviour in Each Condition

Pattern of selecting novel object across trial types	*Word*	*Gesture*
Target trials > control trials	11	4
Target trials = control trials	3	2
Target trials < control trials	2	10

examining whether infants would avoid gesture–word overlap, as they do word–word overlap. We found that infants presented with a novel word selected a novel object, consistent with previous findings that even young word learners avoid verbal lexical overlap (Byers-Heinlein & Werker, 2009; Graham et al., 1998; Halberda, 2003; Houston-Price, Caloghiris, & Raviglione, 2010; Liittschwager & Markman, 1994; Mervis & Bertrand, 1994). In contrast, when presented with a novel gesture, infants reliably selected the familiar object. The fact that 18-month-old infants avoided overlap between two words but were receptive to overlap between a word and a gesture suggests that although infants appear to interpret both words and gestures as object labels at this age (see also Namy, 2001; Namy & Waxman, 1998), their expectations for how gestures versus words name objects differ. That infants do not appear to regard words and gestures as mutually exclusive suggests that, at least by 18 months of age, words and symbolic gestures are not part of a single, undifferentiated lexicon.

This finding was unexpected given the evidence suggesting that words and symbolic gestures are equipotential forms of symbolic reference at 18 months of age. Interestingly, not only did infants in the gesture condition fail to avoid word–gesture overlap, they actually exhibited a tendency to *seek* word–gesture overlap, selecting the familiar object reliably more often than the novel object as the referent of the novel gesture. This outcome does not appear to be driven by infants' overall preference of the familiar object given that they did not reliably select the familiar object on preference control trials.

One possible explanation for this unanticipated finding is that it reflects infants' growing sensitivity to how co-speech gestures are typically used in communication. That is, it is well documented that gestures tend to co-occur with speech in adult communication (Goldin-Meadow, 2009), infant-directed communication (Iverson, Capirci, Longobardi, & Casseli, 1999; Namy & Nolan, 2004; Namy, Vallas, & Knight-Schwartz, 2008; Namy et al., 2000) and in infants' own communicative efforts (Iverson & Goldin-Meadow, 2005; Morford & Goldin-Meadow, 1992). Given that these gestures typically reinforce or augment speech, perhaps infants interpreted the gestures in the present study as elaboration of discourse regarding familiar objects.

Although infants' mapping patterns of novel gestures was unexpected given the evidence on the apparent equipotentiality of words and gestures, the pattern of consistent mapping to the familiar object in the disambiguation paradigm is not without precedents. For example, in a study comparing the disambiguation of novel words to novel verbal facts, Scofield and Behrend (2007) found that although three- and four-year-olds mapped both words and facts onto novel objects (see also Diesendruck & Markson, 2001), two-year-olds mapped novel facts onto *familiar* objects, consistent with the

pattern of gestural mapping by 18-month-olds in the current study. Additionally, in one preferential looking study of verbal disambiguation, Halberda presented 14- to 17-month-olds with a picture of a familiar object (a car) and a picture of a novel object (a phototube). Infants then heard sentences such as, "Wow, Look at the dax!" Halberda found that 17-month-olds looked longer at the novel object, demonstrating the disambiguation effect. However, 14-month-olds looked longer at the *familiar* than the novel object (Halberda, 2003). This pattern raises the possibility that across learning domains (words, facts, gestures), novice learners tend to display a preference for mapping novel information to familiar objects, whereas more sophisticated learners employ more systematic exclusion-based strategies (such as mutual exclusivity or lexical gap filling).

A contrasting account of the differing mapping patterns of words versus gestures is that rather than reflecting 18-month-olds' novice status as gesture learners, performance may reflect a developmental change in lexical organization. That is, perhaps younger infants at the very cusp of word learning integrate verbal and gestural symbols into a unified lexicon but by 18 months of age, their expectations regarding the communicative functions of words and gestures have begun to diverge (Namy & Waxman, 2000; Suanda & Namy, in press). As a result, 18-month-olds may have begun to establish modality-specific lexicons. This development from one undifferentiated lexicon into multiple lexicons accounts well for the discrepancy between the current findings demonstrating that 18-month-olds do not treat words and symbolic gestures as mutually exclusive, and the observational work indicating that younger infants (12- to 16-month-olds) appear to use words and gestures in a mutually exclusive manner (Acredolo & Goodwyn, 1988; Iverson et al., 1994). This view is also consistent with the broader developmental perspective offered by Namy, Woodward, and their colleagues that hearing infants begin the process of word learning accepting many symbolic forms as object labels (Namy, 2001; Namy & Waxman, 1998; Woodward & Hoyne, 1999), but develop a priority for words over other symbolic forms (e.g., gestures, nonverbal sounds) as they gain additional exposure with spoken language.

The extent to which these findings are best accounted for by the novelty of the gesture domain relative to the word domain or developmental change in lexical organization relative to the very onset of word learning may be informed by future research with younger infants. If infants' lack of gestural disambiguation at 18 months is attributed to the novelty of the gesture domain, then we would predict a similar pattern in younger infants. In contrast, if infants do indeed organize words and gestures in an undifferentiated manner at an earlier point in development, as suggested by previous observational work (e.g., Acredolo & Goodwyn, 1988), then a test of disam-

biguation with younger infants may reveal avoidance of word–gesture overlap not evident in the current population. Because the disambiguation task employed here would be difficult to implement with younger infants, we propose that future research employing more indirect measures of disambiguation (e.g., eye tracking, Halberda, 2003) would shed light on this developmental account.

In conclusion, the current study suggests that, contrary to expectations, young word learners do not appear to organize words and gestures in an undifferentiated lexicon. Whereas 18-month-old infants expect that words will not overlap in reference, they exhibit no such expectation regarding word-gesture overlap and instead reliably map gestures to objects for which they know verbal labels. Thus, during a period of development when infants appear to acquire, use and process words and symbolic gestures similarly, there nonetheless exist important differences in the communicative functions of these two symbolic media.

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REFERENCES

Acredolo, L. P., & Goodwyn, S. W. (1988). Symbolic gesturing in normal infants. *Child Development*, *59*, 450–466.

Acredolo, L. P., Goodwyn, S. W., Horobin, K., & Emmons, Y. (1999). The signs and sounds of early language development. In L. Balter & C. Tamis-LeMonda (Eds.), *Child psychology: A handbook of contemporary issues* (pp. 116–139). New York, NY: Psychology Press.

Byers-Heinlein, K., & Werker, J. F. (2009). Monolingual, bilingual, trilingual: Infants' language experience influences the development of a word-learning heuristic. *Developmental Science*, *12*, 815–823.

Capirci, O., Montanari, S., & Volterra, V. (1998). Gestures, signs, and words in early language development. In J. M. Iverson & S. Goldin-Meadow (Eds.), *The nature and functions of gesture in children's communication* (pp. 45–59). San Francisco, CA: Jossey-Bass.

Caselli, M. C. (1994). Communicative gestures and first words. In V. Volterra & C. J. Erting (Eds.), *From gesture to language in hearing and deaf children* (pp. 56–67). Washington, DC: Gallaudet University Press.

Clark, E. V. (2003). *First language acquisition*, New York, NY: Cambridge University Press.

Diesendruck, G., & Markson, L. (2001). Children's avoidance of lexical overlap: A pragmatic account. *Developmental Psychology*, *37*, 630–641.

Fenson, L., Pethick, S., Renda, C., Cox, J. L., Dale, P. S., & Reznick, J. S. (2000). Short-form versions of the MacArthur Communicative Development Inventories. *Applied Psycholinguistics*, *21*, 95–116.

Goldin-Meadow, S. (2009). How gesture promotes learning throughout childhood. *Child Development Perspectives*, *3*, 106–111.

Golinkoff, R. M., Mervis, C. B., & Hirsh-Pasek, K. (1994). Early object labels: The case for a developmental lexical principles framework. *Journal of Child Language*, *21*, 125–155.

Goodwyn, S. W., & Acredolo, L. P. (1998). Encouraging symbolic gestures: A new perspective on the relationship between gesture and speech. In J. M. Iverson & S. Goldin-Meadow (Eds.), *The nature and functions of gesture in children's communication* (pp. 61–73). San Francisco, CA: Jossey Bass.

Graham, S. A., & Kilbreath, C. S. (2007). It's a sign of the kind: Gestures and words guide infants' inductive inferences. *Developmental Psychology*, *43*, 1111–1123.

Graham, S. A., Poulin-Dubois, D., & Baker, R. K. (1998). Infants' disambiguation of novel object words. *First Language*, *18*, 149–164.

Graham, S. A., Turner, J. N., & Henderson, A. M. E. (2005). The influence of object pre-exposure on two-year-olds' disambiguation of novel labels. *Journal of Child Language*, *32*, 207–222.

Halberda, J. (2003). The development of a word-learning strategy. *Cognition*, *87*, B23–B34.

Horst, J. S., Samuelson, L. K., Kucker, S. C., & McMurray, B. (2011). What's new? Children prefer novelty in referent selection *Cognition*, *118*, 234–244.

Houston-Price, C., Caloghiris, Z., & Raviglione, E. (2010). Language experience shapes the development of the mutual exclusivity bias. *Infancy*, *15*, 125–150.

Iverson, J. M., Capirci, O., & Caselli, M. C. (1994). From communication to language in two modalities. *Cognitive Development*, *9*, 23–43.

Iverson, J. M., Capirci, O., Longobardi, E., & Casseli, M. C. (1999). Gesturing in mother-child interaction. *Cognitive Development*, *14*, 57–75.

Iverson, J. M., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. *Psychological Science*, *16*, 367–371.

Liittschwager, J., & Markman, E. M. (1994). Sixteen- and 24-month-olds' use of mutual exclusivity as a default assumption in second-label learning. *Developmental Psychology*, *30*, 955–968.

Markman, E. M., & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meanings of words. *Cognitive Psychology*, *20*, 121–157.

Markman, E. M., Wasow, J. L., & Hansen, M. B. (2003). Use of the mutual exclusivity assumption by young word learners. *Cognitive Psychology*, *47*, 241–275.

Merriman, W. E., & Bowman, L. (1989). The mutual exclusivity bias in children's word learning. *Monographs of the Society for Research in Child Development*, *54* (3–4, Serial No. 220).

Merriman, W. E., & Schuster, J. (1991). Young children's disambiguation of object name reference. *Child Development*, *62*, 1288–1301.

Mervis, C. B., & Bertrand, J. (1994). Acquisition of the Novel Name-Nameless Category (N3C) principle. *Child Development*, *65*, 1646–1662.

Morford, M., & Goldin-Meadow, S. (1992). Comprehension and production of gestures in combination with speech in one-word speakers. *Journal of Child Language*, *19*, 559–580.

Namy, L. L. (2001). What's in a name when it isn't a word? 17-month-olds' mapping of nonverbal symbols to object categories. *Infancy*, *2*, 73–86.

Namy, L. L., Acredolo, L., & Goodwyn, S. (2000). Verbal labels and gestural routines in parental communication with young children. *Journal of Nonverbal Behavior*, *24*, 63–79.

Namy, L. L., Campbell, A. L., & Tomasello, M. (2004). The changing role of iconicity in nonverbal symbol learning: A U-shaped trajectory in the acquisition of arbitrary gestures. *Journal of Cognition and Development*, *5*, 37–57.

Namy, L. L., & Nolan, S. A. (2004). Characterizing changes in parent labeling and gesturing and their relation to early communicative development. *Journal of Child Language*, *31*, 821–835.

Namy, L. L., Vallas, R., & Knight-Schwartz, J. (2008). Linking parent input and child receptivity to symbolic gestures. *Gesture*, *8*, 302–324.

Namy, L. L., & Waxman, S. R. (1998). Words and gestures: Infants' interpretations of different forms of symbolic reference. *Child Development*, *69*, 295–308.

Namy, L. L., & Waxman, S. R. (2000). Naming and exclaiming: Infants' sensitivity to naming contexts. *Journal of Cognition and Development*, *1*, 405–428.

Pearson, B. Z., Fernandez, S., & Oller, D. K. (1995). Cross-language synonyms in the lexicons of bilingual infants: One language or two? *Journal of Child Language*, *22*, 345–368.

Prinz, P. M., & Prinz, E. A. (1981). Acquisition of ASL and spoken English by a hearing child of a deaf mother and a hearing father: Phase II, early combinatorial patterns. *Sign Language Studies*, *30*, 78–88.

Quay, S. (1995). The bilingual lexicon: Implications for studies of language choice. *Journal of Child Language*, *22*, 369–387.

Scofield, J., & Behrend, D. A. (2007). Two-year-olds differentially disambiguate novel words and facts. *Journal of Child Language*, *34*, 875–889.

Sheehan, E. A., Namy, L. L., & Mills, D. L. (2007). Developmental changes in neural activity to familiar words and gestures. *Brain and Language*, *101*, 246–259.

Shore, C., Bates, E., Bretherton, I., Beeghly, M., & O'Connell, B. (1994). Vocal and gestural symbols: Similarities and differences from 13 to 28 months. In V. Volterra & C. J. Erting (Eds.), *From gesture to language in hearing and deaf children* (pp. 79–91). Washington, DC: Gallaudet University Press

Suanda, S. H., & Namy, L. L. (in press). Young word learners' interpretations of words and symbolic gestures within the context of ambiguous reference. *Child Development*.

Volterra, V., & Taeschner, T. (1978). The acquisition and development of language by bilingual children. *Journal of Child Language*, *5*, 311–326.

Woodward, A. L., & Hoyne, K. L. (1999). Infants' learning about words and sounds in relation to objects. *Child Development*, *70*, 65–77.