Child Development, March/April 2006, Volume 77, Number 2, Pages 266–280

The Birth of Words: Ten-Month-Olds Learn Words Through Perceptual Salience

Shannon M. Pruden and Kathy Hirsh-Pasek
Temple University

Roberta Michnick Golinkoff
University of Delaware

Elizabeth A. Hennon
University of Evansville

A core task in language acquisition is mapping words onto objects, actions, and events. Two studies investigated how children learn to map novel labels onto novel objects. Study 1 investigated whether 10-month-olds use both perceptual and social cues to learn a word. Study 2, a control study, tested whether infants paired the label with a particular spatial location rather than to an object. Results show that 10-month-olds can learn new labels and do so by relying on the perceptual salience of an object instead of social cues provided by a speaker. This is in direct contrast to the way in which older children (12-, 18-, and 24-month-olds) learn and extend new object names.

To borrow from Gertrude Stein, word learning is word learning is word learning. Or is it? Are first words learned in the same way that later words are learned? Increasingly, researchers are finding that children are sensitive to aspects of word meaning within the first year of life. For example, Tincoff and Jusczyk (1999) found that 6-month-old infants could pair the word ''mommy'' with videos of their own mothers. Furthermore, infants as young as 7 months can detect arbitrary relations between vowel sounds and objects (Gogate & Bahrick, 1998). By 11 months of age, infants seem to recognize that words refer to commonalities across categories of objects (Waxman & Booth, 2003). Twelve-month-olds can be trained on a set of words and extend them to new exemplars in a comprehension task (Schafer, 2005). Finally, and still before many infants produce their first words, 13-month-olds demonstrated their ability to map a word to an object and to retain the label for up to 24 hr (Woodward, Markman, & Fitzsimmons, 1994). Maternal report offers converging evidence for these laboratory studies, suggesting that at 10 months infants have up to 10 words in their comprehension vocabulary (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994). The mounting evidence suggests, then, that by the second half of the first year, infants are reliably mapping arbitrary sounds onto meanings. Although we know that they learn words, little is known about how they perform this mapping and whether it is achieved in a way that parallels what toddlers do when they become veteran word learners at 24 months of age (Hollich, Hirsh-Pasek, & Golinkoff, 2000).

Words are the building blocks of language. They are the social and mental currency through which we represent our world and communicate with others. Word learning in children and adults is also unlike most other kinds of learning. Much of human and animal learning is associative, achieved through temporal contiguity and repetition. Word learning, however, is considered by many to be more than just forming associations between repeated pairings of an object with a name (Baldwin, 1991; Bloom, 2000; Tomasello, 1992). Rather, these researchers assume that even the earliest word learning reflects sensitivity to the social intent of the speaker. Tomasello, for example, argues that this sensitivity to social intent distinguishes us from other species, including primates (Tomasello, 1999; Tomasello & Call, 1997), and seems to be on-line by 12–18 months of age (Gergley, Nadasdy, Csibra, & Biro, 1995).

This research was supported by NSF grants SBR9601306 and SBR9615391 to Kathy Hirsh-Pasek and Roberta Golinkoff and by NICHD grant 3U10HD25455-0552 to Kathy Hirsh-Pasek.

We thank Kim Cassidy, Helene Intraub, and Nora Newcombe for their helpful comments on earlier versions of this paper. We also thank Natalie Hansell, Amanda Brandone, Sara Salkind, Meredith Jones, Jenny Sootsman, and Carly Slutzky for their assistance in data collection. Finally, we thank Ellen Markman for inspiring us to conduct this study.

Correspondence concerning this article should be addressed to Kathy Hirsh-Pasek, Psychology Department, Weiss Hall, Temple University, Philadelphia, PA 19122. Electronic mail may be sent to khirshpa@temple.edu.

Children are sensitive to social information in the first year of life (Carpenter, Nagell, & Tomasello, 1988; Morales, Mundy, & Rojas, 1998). Learning words, however, requires that they not only attend to social information (such as eye gaze direction) but also use it as a window to a speaker's intent (Hollich et al., 2000). In this way, children become apprentices to master word users and rapidly increase their vocabularies. Even though the evidence for intention-based word learning is scarce before 18 months, some make the argument that children must be using social cues from the outset of language development (e.g., Bloom, 2000). After all, infants are bathed in social information and language is fundamentally social (Snow, 1999; Tamis-LeMonda, Bornstein, Baumwell, Kahan-Kalman, & Cyphers, 1998; Tomasello & Farrar, 1986).

The role of social intent in word learning seems to be well established. By way of example, Baldwin et al. (1996) found that 18-month-olds learned a name for a novel object only when the speaker's intent to name it was clear. If a name was said with great excitement when the child was attending to an object, but the speaker failed to look toward the object, the word never entered the child's vocabulary. Thus, the ability to detect and use a speaker's social intent may be a necessary condition for learning words (Baldwin & Tomasello, 1998). As Akhtar and Tomasello (1998) suggest, ''Although learning object labels may appear to involve straightforward mapping of word to referent . . . it also requires the social-cognitive ability to tune into speakers' referential intention'' (p. 130). Both 18- and 24-month-olds can do this, although at 18 months, the ability is still fragile (Moore, Angelopoulos, & Bennett, 1999). Children can be drawn away from the object the speaker intends to label to attach the label to a more exciting object. Yet, at 18 months, children begin to map a word to the object the speaker indicates even when it conflicts with the object they prefer (Hirsh-Pasek, Golinkoff, & Hollich, 2000; Hirsh-Pasek, Golinkoff, Hennon, & Maguire, 2004).

There is no doubt that attention to social intent is fundamental to rapid vocabulary learning when words are learned without ostensive definition. However, before 12 months of age, infants do not necessarily attribute social intent to speakers. Before they are 18 months of age, they seem not to recruit their knowledge of social intent in word learning (Adamson, 1995; Baldwin et al., 1996; Hollich et al., 2000). This presents a puzzle: how are infants, without access to speakers' social intent, learning words as early as 6 months (Benedict, 1979; Fenson et al., 1994; Tincoff & Jusczyk, 1999)? The challenge is to uncover the mechanism by which children, both at the very beginning and later in their journey, acquire new words. This paper addresses this question head-on by asking whether 10-month-olds can learn a novel word for a novel object in the absence of attention to social intent.

This challenge has received special attention in the past 20 years. Smith (1995), for example, argues that ''dumb attentional mechanisms'' help children attend to the co-occurrence between objects and words. If social information makes a difference for word learning, it does so because it heightens an object's salience relative to its surroundings (Baldwin & Markman, 1989; Samuelson & Smith, 1998; Smith, 2000; Woodward & Hoyne, 1999; Woodward et al., 1994). On this view, specific attention to referential intention is less necessary at the outset: infants could begin to learn words in the same way that infrahuman species learn to pair an arbitrary response with a stimulus. ''Words are not special attention cuers initially but become special through their continued and repeated use by others to bring attention to objects'' (Smith, 2000, p. 62). Words become associated with objects in the same way that logograms (Namy, 2001), nonlinguistic gestures (Namy, 2001), or object noises (Woodward & Hoyne, 1999) become linked to referents.

In a similar vein, Werker, Cohen, Lloyd, Casasola, and Stager (1998) suggest that early word learning is best described as ''word–object associations.'' In a series of studies, they find that 14-month-olds, but not younger children, can learn word–object pairings under tightly controlled laboratory conditions and without the use of social or contextual information. Children who succeeded in their task did so because they formed an arbitrary association between a word and a referent. Woodward et al. (1994), studying word learning in 13- and 18-month-old children, put it best when they speculated,

> Perhaps prenaming explosion children have highly effective nonlinguistic associative mechanisms that allow them to map sound patterns onto the environmental entities that are presented with them, whereas postnaming explosion children learn words through more advanced linguistic mechanisms (p. 564).

Golinkoff, Hirsh-Pasek, and Hollich (1999), Hirsh-Pasek et al. (2004), and Hollich et al. (2000) proposed that children use different word-learning mechanisms across early development. Early on at 12 months, infants learn words by mapping them to perceptually interesting objects; by 18 months, children

learn words through attention to social cues. Their emergentist coalition model holds that children have access to a number of co-occurring cues for word learning, including perceptual, social, and linguistic cues. In the beginning, names may be mapped only to the most salient object in the environment from the infant's point of view. Later, however, the social cues a speaker offers may provide a window into a speaker's intention for word meaning. Once infants appreciate the importance of social intent, words are mapped to objects from the speaker's point of view and the child, as apprentice, has access to a richer lexicon from his more informed mentor.

Only one empirical investigation has pitted social cues against perceptual salience cues to investigate the possibility that the word-learning process changes over time. Hollich et al. (2000) performed a series of studies examining the effects of competing perceptual and social cues on word learning in 12-, 19-, and 24-month-olds. Children were presented with novel objects, one interesting and one boring, and given the opportunity to explore each one. The objects were then placed side by side on a display board while the experimenter enthusiastically looked at, pointed to, and labeled either the interesting (coincident) or boring (conflict) toy. For 19- and 24-month-olds, attention to social information was sufficient to guarantee word learning irrespective of whether the speaker labeled the object that, from the infant's perspective, was interesting or boring. That is, children readily accepted the novel name for the object that was signaled through speaker intent. These toddlers overcame the perceptual lure of an interesting object and readily attached the novel label to the object the speaker indicated—even when it was the boring one.

Twelve-month-olds, however, showed a different pattern. Social information was necessary, but not sufficient, to ensure word learning. They could learn a label when social and perceptual cues were "in alignment" and the speaker labeled the interesting object. When the speaker labeled the boring object, word learning fell apart. However, the 12-month-olds were doing more than attaching a label to the most interesting available object; they were sensitive to cues for social intent, even though they could not use them to map a label onto the boring object. Had they failed to detect the social cues, they should have formed a mismapping between the label and the interesting object.

The Hollich et al. (2000) findings raise a question first broached by Woodward et al. (1994): Is there ever a time in word acquisition when the use of perceptual cues and perceptual salience is paramount to word learning? Might 10-month-olds use perceptual salience as a primary strategy for mapping words to referents? To investigate this question, this paper explores what 10-month-old infants will do when the social and perceptual cues are put into conflict. We focus on comprehension as the method of investigation because, as Woodward et al. (1994) explain, comprehension "provides a more sensitive index of increased word learning competence, because the child's comprehension of words is not limited by factors that may limit language production, such as level of articulatory control, recall memory, and motivation to talk" (p. 554). If infants are able to learn novel words, but do this without harnessing any social information, then they must be learning the words through some other mechanism.

We hypothesize that at the very beginning of the language-learning process, infants are mapping words onto the most perceptually interesting objects in their environment. Three predictions follow from this argument. First, 10-month-olds will learn a novel word. Second, because they are not yet using social intent for word learning, they will not recruit the social cues indicating that the speaker is naming the boring object. Third, they will map words onto objects that are perceptually interesting to them, resulting in their mismapping the word onto the interesting object, even when the word was intended to name the boring object. Two studies test these predictions.

Study 1: If 10-Month-Olds Can Learn a Word, How Do They Do It?

The first study was designed for two reasons. First, it was important to establish whether infants of this age could even learn a word in an experimental task. Second, using the same method employed by Hollich et al. (2000), the interactive intermodal preferential looking paradigm (IIPLP), we test the hypothesis that 10-month-olds will learn words by relying on perceptual salience. That is, infants will fail to utilize the social cues indicating that a word is naming the boring object, and attach the label to the interesting object. If this prediction holds, then the outcome should be the same regardless of whether the interesting or the boring object is named: the novel word should be mapped to the interesting object.

Method

Participants. Seventy-seven monolingual, English-reared, full-term infants were recruited and 44 infants (mean age = 10.47 months; range = 9.89–11.07), balanced for gender, formed the final sample.

Data from an additional 33 children were discarded because of fussiness (5), low attention (14), side bias (2), and experimenter error/equipment failure (12). This attrition rate is not unusual for children of this age. Infants making up the final sample were predominantly white and from middle-class homes in suburban Philadelphia.

Materials. Mothers completed the infant version of the MacArthur Communicative Development Inventory (Fenson et al., 1994), a parental report measure of early language development. An abbreviated version, the ''MacArthur Short Form Vocabulary Checklist: Level 1'' contains 89 words known to be common in infants' vocabularies. The parent is required to mark if their child understands or says each word. Here, the production score was equal to the number of words that the parent reported the child said. The comprehension score was equal to the total number of words that the child said plus those that the child understood. The average number of words produced was 1.45 ($SD = 2.91$); the mean number comprehended was 13.64 ($SD = 13.90$).

Apparatus. Infants were tested using the IIPLP (Figure 1). The infant sat on a blindfolded parent's lap 75 cm back from the center of a modified Fagan board on a table (Fagan, 1971; Hollich et al., 2000). This modified board had a base (55 cm × 50 cm) and a hinged board (40 cm × 50 cm). The display board was painted black on one side with Velcro attachments at 20 cm from the top and 12.5 cm from either side (providing two sites for attaching objects 30 cm apart). The board was hinged so that it could rotate lengthwise, pivoting to hide or reveal whatever objects might be attached, and thereby providing precise control over the duration of exposure. A specially designed timer (Infant Test Timer) was used that could be set to produce a brief tone. A mirror behind the infant allowed the video camera to record the reflection of the objects on the board and held by the experimenter. Infants' looking responses were captured on the video at the same time. Coding was completed off-line.

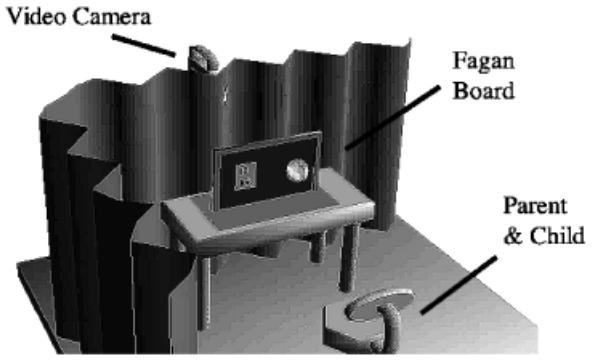

Figure 1. Interactive intermodal preferential looking paradigm . The child sits on his or her parent's lap in front of the flip board. The experimenter stands behind the flip board. A hidden camera behind the curtain records children's looking preferences toward two objects on the display board.

Stimuli. The stimuli consisted of four novel, small, unfamiliar household objects or toys. These objects were chosen for two reasons: (1) infants were unlikely to have names for these objects and (2) these objects varied in their perceptual salience. Two of these objects, a blue sparkle wand and a red, green, and pink party clacker, were brightly colored and either made noise or had moving parts (see Figure 2). These objects were deemed the ''interesting objects'' as they were thought to be highly salient to the infants. The other two objects, a white cabinet latch and a beige bottle opener, were dull in both color and appearance. These objects were deemed the ''boring objects.'' An interesting and a boring object were paired together to create an ''interesting–boring object set.'' For example, the sparkle wand was always paired with the cabinet latch, while the party clacker was always paired with the bottle opener. Importantly, experimenter judgments of ''boring'' and ''interesting'' were validated by the infants themselves within the course of the testing procedure.

The four novel labels were chosen to be perceptually distinct. They were ''modi'' and ''glorp'' (both one syllable) and ''dawnoo'' and ''blicket'' (both two syllables). The one-syllable words were always paired together as were the two-syllable words.

Procedure. Participants completed a four-phase study in which visual fixation time served as the dependent variable. The independent variable was whether they were in the coincidental condition, in which the experimenter looked at and labeled the interesting object, or the conflict condition, in which the experimenter looked at and labeled the boring object. Twenty-three children were in the coincidental condition and 21 were in the conflict condition. The interesting–boring object sets were also counterbalanced across conditions such that in some cases the wand and latch came first and in some cases the clacker and the bottle opener came first.

In the *exploration* phase, infants played sequentially with an interesting and a boring novel object (in counterbalanced order) for 26 s each. The purpose of the exploration phase was to give the child a chance to have a full range of experiences (touching, looking, tasting, and banging) with the objects and to lay the groundwork for subsequent social interaction.

In the *salience* phase, infants saw the two objects placed side by side on the rotating board for 6 s. The

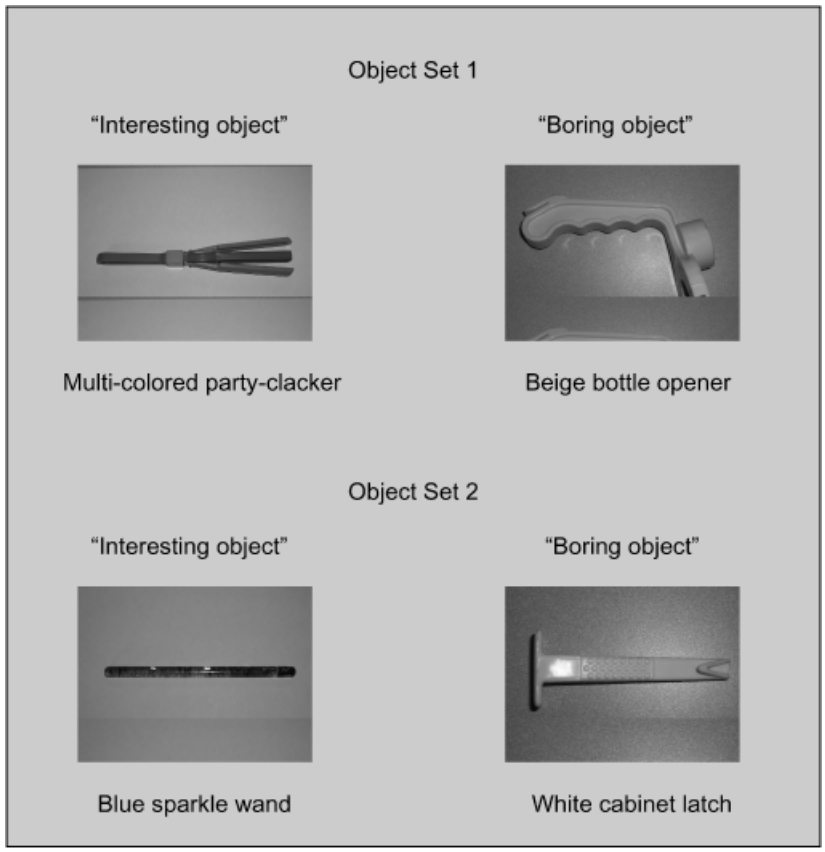

Figure 2. Stimuli used across both studies. An ''interesting object'' was always paired with a ''boring object.'' Two object sets were used. The multicolored party clacker was always paired with the beige bottle opener (object set 1), where as the blue sparkle wand was always paired with the white cabinet latch (object set 2).

experimenter hid behind the board and said, ''Jordan, look up here. What's on the board? What do you see?'' The experimenter hid behind the board during the salience phase in order to limit the possibility of influencing the child's response. The purpose of the salience phase was to assess infants' relative interest in the novel objects. The prediction was that longer looking would occur to the interesting objects than to the boring objects.

Infants were randomly assigned to one of two, between-subjects conditions for the *training* phase. The experimenter placed the two objects side by side on the table in front , but out of reach, of the child. In the coincidental condition, the experimenter stood up behind and midway between the two objects, looked only at the interesting object, and labeled it five times (e.g., ''Jordan, look a modi! Wow, it's a modi! Look, a modi! Jordan, look a modi! It's a modi!''). In the conflict condition, the experimenter did the same thing, but looked at and labeled the boring object using exactly the same sentences. In both conditions, the experimenter proceeded with labeling the object only after the infant's attention was captured and the infant made eye contact with the experimenter.

Finally, the *testing* phase had four components, each of which was 6 s in duration. During the first two test trials (original-label trials), the experimenter hid behind the center of the testing board on which infants saw the two objects side by side. After hiding, the experimenter asked the child to look at the target object saying, ''Jordan, where is the modi? Can you find the modi? Do you see the modi?'' If infants learned the intended label, then they should look more at the target object than at the nontarget object. If they were only looking at the object that interested them, they should look continuously at the interesting object, regardless of whether it was named by the speaker. Importantly, most studies evaluate word learning solely on the basis of testing trials like our first two test conditions (see Hollich et al., 2000, for a review).

A more stringent test of word learning: In addition to these original- test trials, we also included a third

and fourth test trial. These additional test trials were used to assess whether infants were truly pairing a label with an object rather than simply attending to the more interesting object. The logic of the additional test trials is this: If children attached a label to the interesting object, then they should look away from the interesting object if they hear a new label and should return to looking at the interesting object only when they again hear the original label. This rationale is based on the assumption that even very young infants might operate with the word-learning constraint of ''mutual exclusivity'' (Markman, 1989). Mutual exclusivity suggests that children will attach only one category label to an object. It should be noted that ''mutual exclusivity'' has not been demonstrated in children younger than 18–20 months of age (Markman, Wasow, & Hansen, 2003), with the majority of research on ''mutual exclusivity'' addressing word learning in 2- and 3-year-olds. Thus, the third trial in this experiment not only offers a stringent test of word–label mapping, but also asks whether mutual exclusivity is a fair assumption of children this young.

In this third, new-label test trial, infants were asked to look at the ''glorp'' rather than at the ''modi.'' It was predicted that if children thought that the target object already had a name (here ''modi''), the new name (here ''glorp'') should cause them to look away from it so that they could find the referent for the new name.

In the fourth test trial, the recovery trial, infants were again asked to look at the ''modi.'' If infants had indeed learned the original name for the object, they should renew their looking to the target. All infants participated in two blocks of trials, inviting them to learn two novel words.

To assess whether the infants could learn a word, their responses were observed in the test trials for the coincident and conflict conditions as well as in the pattern of their responses over the four types of test trials. In particular, to say that they had learned a word, infants either needed to look at the interesting object in the first two test trials or, more compellingly, needed to look at the target during the first pair of test trials, look away during the third trial (the new-label trial), and then renew their looking toward the target object during the recovery test trial.

To assess how infants map words onto objects, infants' responses in the two conditions were monitored. If infants in the coincidental condition learned the words, they would look longer at the interesting object in the original- test trials, look away during the new-label trial, and show increased looking at the interesting object during the recovery trial. If 10-month-olds were able to use social cues in service to word learning, infants in the conflict condition should look longer at the boring object in the original-label trials, look away during the new-label trial, and show increased looking at the boring object during the recovery trial. This pattern of looking would be consistent with the 18-month-olds in the Hollich et al. (2000) studies. However, if infants were guided by perceptual saliency alone, then regardless of condition, they should label the interesting object, ignoring the speaker's eye gaze to the boring object in the conflict condition. Such a pattern would be revealed if infants in both the coincidental and conflict conditions looked at the interesting object during the original- test trials, looked away from it during the new-label trial, and then looked back at the interesting object during the recovery trial. Such a pattern would be revealed if children's responses across the two conditions did not differ.

Coding. Children's visual fixation data during the salience, training, and test phases were coded for three things: (a) visual fixation time toward the right object or the left object, (b) attention to the experimenter, and (c) visual fixation time at neither the objects nor the experimenter. Coders were blind to experimental condition. Coders were rarely those who conducted the testing (only 15% were both the coder and experimenter), and when they were, they waited 7 days in between the live test and the coding. Only after the coding was completed, did the coders check to see which of the toys served as the target object.

Coders were trained to consistently meet a standard of 95% reliability for both inter- and intrajudge codings. In the case of intrajudge reliabilities, a minimum of 1 week elapsed between codings. Further, 15% of all videotapes were coded by a second person for inter-coder reliability ($r = .96$).

Results

Preliminary analyses indicated that neither gender nor object set had a significant effect. Therefore the data across object set and gender were pooled. For each child, a proportion of looking time was calculated by dividing the number of seconds spent looking at the interesting object by the number of seconds spent looking at both the interesting and boring objects. Thus, any value greater than .50 indicated a preference for the interesting object, and any value less than .50 indicated a preference for the boring object. This proportion was calculated for all trials—salience, training, and test across all conditions.

An independent samples *t*-test was conducted to assess whether infants in the two conditions performed differently during the salience phase. No difference was found between the children participating in the conflict and coincidental conditions, $t(42) = -.832$, $p > .05$ (Figure 3). Thus, the two conditions were pooled. The proportion of looking time to the interesting object was compared with a chance value of .50 using a one-sample *t*-test. Infants had a significant preference for the interesting object during salience ($M = .556$, $SD = .139$), $t(43) = 2.672$, $p < .05$.

We also examined the looking times during the training phase to assess whether infants were paying attention to the interesting object, even when they were in the conflict condition. An independent samples *t* test was conducted to assess if there were any differences between the two conditions. During the training phase, the two conditions were not significantly different, $t(42) = 0.834$, $p > .05$, hence the conditions were pooled. A one-sample *t* test, compared with chance, was conducted to see if infants were looking longer at either object. Infants looked significantly longer at the interesting object during the training trial ($M = .663$, $SD = 0.140$), $t(43) = 7.730$, $p < .001$, regardless of condition (Figure 4).

In the test trials, did infants in the coincident trial respond like those in the conflict condition? Data for the test trials were analyzed in a 2 (condition) × 3 (test trials: original label, new label, recovery) repeated measures ANOVA. Data from the two trials that comprised the original-label test trials were averaged. Neither a main effect of condition nor an interaction between condition and test trial was found (*p*s > .05). However, a main effect of test trial was found, $F(2, 84) = 3.556$, $p < .05$. Post hoc contrast analyses verified that this was due to a quadratic pattern across trials, $F(1, 42) = 5.618$, $p < .05$ (Figure 5). One-sample *t* tests (compared with a chance value of .50) revealed that infants allocated significantly more attention to the interesting object during the original-label trials, $t(43) = 3.328$, $p < .01$, looked less at the interesting object during the new-label trial, $t(43) = 1.636$, $p > .05$, and then renewed their looking time to the interesting object during the recovery test trial, $t(43) = 4.006$, $p < .001$. This pattern was not influenced by condition. In other words, infants attached the new label to the interesting object regardless of which object the speaker labeled.

Word learning was thus found under the traditional and more stringent tests, in both the first two test trials and across the four test trials. Remarkably, infants in this study showed evidence of word learning as demonstrated through the new-label and recovery trials. This is an extraordinary feat for 10-month-olds and has not yet been demonstrated on infants this age. Had infants only looked at the interesting object throughout the four test trials, these data would simply have shown a preference for the interesting objects and no evidence of word

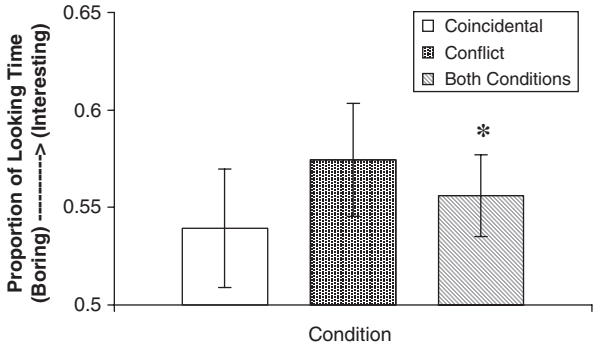

Figure 3. Infants' looking times during the salience trial. The *y*-axis depicts a proportion of looking time to the interesting object. A number greater than .50 indicates a preference for the interesting object, where as a number below .50 indicates a preference for the boring object. $^{*}p < .05$.

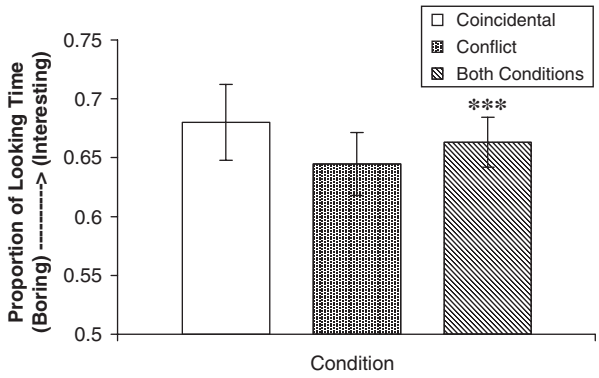

Figure 4. Infants' looking times during the training trial. $^{***}p < .001$.

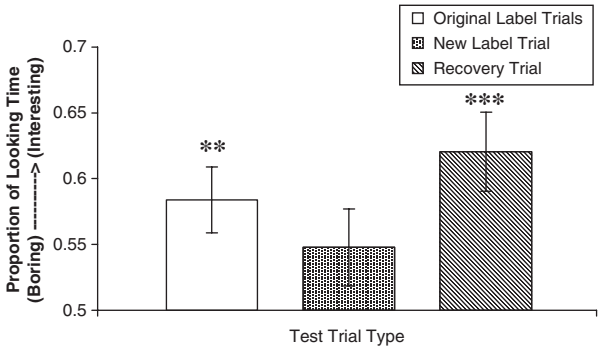

Figure 5. Infants' looking times across the three test trials: original label, new label, and recovery. $^{**}p < .01$. $^{***}p < .001$.

learning. The finding that infants looked away from the interesting objects in the new-label trials and renewed their looking to the interesting objects on the recovery trials provides compelling evidence that they had attached a label to the interesting objects in this task. Given their responses on the new-label and recovery trials, infants may be showing an early precursor to mutual exclusivity (Markman, 1989). Thus, regardless of condition, infants mapped novel words to novel objects they found compelling, disregarding the speaker's social cues.

Coincidental condition analyses. Although we did not find a significant difference in performance between those infants in the coincident and conflict conditions at test, we wanted to ensure that neither condition was driving the resulting main effect of test trial and the quadratic pattern. Thus, we conducted post hoc contrasts on each individual condition to determine if infants had attached the label to the interesting object during the three types of test trials (i.e., original label, new label, and recovery).

Three one-sample t tests comparing infants' looking times with a chance value of .50 were conducted on the test trial data in the coincidental condition. These tests indicated that infants participating in the coincidental condition looked significantly longer at the interesting object during the original-label test trials, $t(22) = 2.859$, $p < .01$, but did not have a preference for either object during the new label, $t(22) = 1.34$, $p > .05$. Infants in the coincidental condition showed a trend toward looking at the interesting object during the recovery trial, $t(22) = 1.840$, $p = .08$. Figure 6 depicts the quadratic trend for infants participating in the coincidental condition. Fully 21 of 23 (sign test; $p < .001$) or 91% of the 10-month-olds in this study learned at least one word.

Conflict condition analyses. Post hoc contrasts were also performed on the conflict condition data from the three types of test trials (i.e. original label, new label, and recovery). Three one-sample t-tests (comparing infants' looking times with a chance value of .50) revealed that infants participating in the conflict condition showed a trend toward looking longer at the interesting object during the original-label test trials, $t(20) = 1.818$, $p = .08$. They did not have a significant preference for either object during the new label, $t(20) = .931$, $p > .05$, but renewed their looking toward the interesting object during the recovery trial, $t(20) = 4.361$, $p < .001$. Figure 7 shows the pattern of looking across the three test trials for infants participating in the conflict condition. Fifteen of the 21 (sign test; $p = .07$) infants in this condition learned at least one word.

Post hoc analyses. Finally, we wanted to directly assess the role that perceptual salience plays in early word learning. To do so we examined the specific link between performance on the salience trial and actual word learning in this study. A correlation between performance on the salience phase and the original-label test trials revealed that infants who had a salience preference for the interesting objects were more likely to attach a novel word to the interesting object during the original-label trials, $r(44) = .36$, $p < .05$. These results lend further support to the idea that perceptual salience is driving early word learning.

Discussion

The results suggest that infants as young as 10 months of age can learn new words under the minimal exposure conditions in this paradigm. This is consistent with some of the earlier work in the literature suggesting that infants can learn words in the first year of life (Oviatt, 1980; Schafer, 2005). On average, 80% of the infants learned at least a single word. Furthermore, they mapped these words to novel objects with only five exposures to the words. At a time when they have only 12–13 words (on average) in their receptive vocabularies, they were

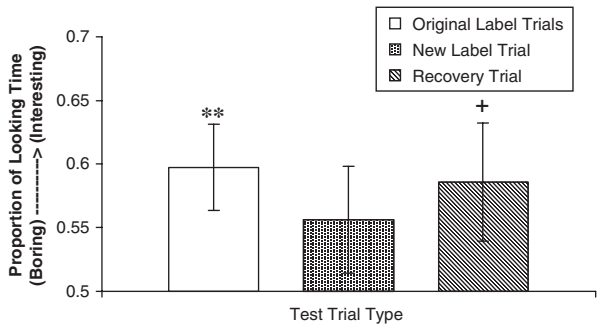

Figure 6. Coincidental condition only: infants' looking times during the three test trials. $^{**}p < .01$. $^{+}p = .08$.

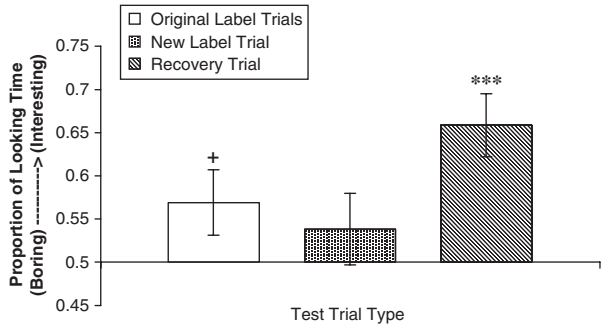

Figure 7. Conflict condition only: infants' looking times during the three test trials. $^{***}p < .001$. $^{+}p = .08$.

able to map novel words to novel objects. Recall that babies were tested in the same way in which they were trained. This may have made it easier for 10-month-olds to show evidence of learning. They were also tested immediately, with no delay. Whether they would retain these words over time and whether they would extend these words to new exemplars is an open question (Hennon et al., in preparation).

Even with these open questions, the data provide strong evidence that, at minimum, infants yoked the labels to referents. At first blush it may seem that all we have shown is that these infants prefer to look at interesting objects. However, infants did not merely fixate on the interesting object with total disregard for the boring object. They examined the boring object throughout the task. In fact, infants in the training phase visually fixated on the boring object for approximately 2.23 s and visually fixated on the interesting object for an average of 4.40 s. Further, and importantly, in the new-label test trial, infants looked away from the interesting object, returning to it only during the recovery trial when it was requested again by name. These data suggest that 10-month-olds can map words to referents with surprising alacrity.

Second, the results suggest that infants were largely indifferent to the social intent of the speaker with respect to which object was being labeled. The fact that infants in the coincidental condition learned words does not speak to this finding. All that infants in that condition needed to do was follow their own interest toward the object that coincided with the object that the speaker was labeling. Data from the conflict condition, however, allow us to conclude that infants ignored the social cues. In that condition, the speaker named the boring object, which the salience trials indicated that babies did not find attractive. The fact that they mapped words to objects in that condition, and that the words were attached to the interesting object, indicates that speaker intent was not used to facilitate the mapping of word to referent. They took the labels they heard as mapping to the objects they liked best. Only by pitting perceptual against social cues in this task were we able to tease apart how young infants solve the problem of word learning. These findings suggest that social intent, while valuable and sufficient for later word learning, is not necessary for first words to be learned.

Third, this study suggests that infants at 10 months of age have at least some precursors to mutual exclusivity in that they expect a new label to be associated with a new object. Whether this is mutual exclusivity per se or whether infants simply respond to new things is an open question. Also open is whether infants would demonstrate this sophistication in more demanding paradigms.

Finally, the fact that infants mismapped the novel words to the interesting objects even when the speaker named the boring objects is prima facie evidence that infants used perceptual strategies to link word and object. The results suggest that infants treated the conflict and the coincidental conditions in precisely the same way. Those tested in the conflict condition, when the boring object was labeled, made the assumption that the word referred to the interesting object—to the object that they preferred rather than the speaker had in mind. The finding that 10-month-olds consistently mismap distinguishes these infants from their 12-month-old counterparts in the Hollich et al. (2000) study. Apparently, early word learning uses different processes than later word learning. Initially, infants appear to be operating in a purely associative manner, attaching the name to the object that they find most compelling.

Study 2: Are 10-Month-Olds Mapping Words to Objects or to Spatial Locations?

The data from Study 1 suggest that infants are mapping words onto objects by the time they are 10 months. Yet, an alternative interpretation is possible. For any given child the interesting and boring objects were always presented on the same side throughout the training and testing procedure. It is thus possible that infants paired the label in training with a particular spatial location. That is, perhaps they felt that label was the name for side of the display (left or right) rather than for the object. The purpose of the second study was to tease apart the two interpretations of word-to-object versus word-to-spatial location mapping. Would 10-month-old infants still find the target they had been trained on if it changed sides from training to test trials?

Method

Participants. Fifty-two monolingual, English-reared, full-term infants were recruited and 32 infants (mean age = 10.54 months; range = 9.89–11.23), balanced for gender, constituted the final sample. These infants were predominantly white and from middle-class, suburban Philadelphia homes. Data from 20 children were discarded because of fussiness (1), low attention (5), side bias (5), parental interference (2), and experimenter error/equipment failure (7). The average number of words produced was 1.41 ($SD = 2.49$); the mean number comprehended was 12.06 ($SD = 8.50$).

Procedure. The procedure was the same as in Study 1 with one important change. Now, the target object during salience and training trials was on one side of the board where as the target object during testing occurred on the other side of the board. By way of example, in the conflict condition, the child saw the boring object on the left side of the board during the salience and training trials, but then saw that object appear on the right side of the board during the four test trials.

Results

Preliminary analyses indicated that neither gender nor object set yielded a significant effect; thus the data were pooled. For each child, a proportion of looking time was calculated by dividing the number of seconds spent looking at the interesting object by the number of seconds spent looking at both the interesting and boring objects. This proportion was calculated for all trials—salience, training, and test across all conditions.

An independent samples t test assessed whether infants participating in the two conditions of our study performed differently during the salience phase. No difference was found between conditions, $t(30) = -1.36$, $p > .05$, and the data were pooled across condition (Figure 8). A one-sample t test assessed whether infants looked longer at the interesting object during the salience trial, and results indicated that they did ($M = .586$, $SD = 0.152$), $t(31) = 3.21$, $p < .05$. Infants preferred the interesting object to the boring object during the salience phase.

We then asked whether children attended to the interesting object during training, irrespective of which object was being labeled. An independent samples t test assessed if there were differences between the two conditions (conflict and coincidental) during the training phase. The conditions were not significantly different, $t(30) = 1.27$ $p > .05$, and the data were pooled. A one-sample t test found that infants looked significantly longer at the interesting object during the training phase ($M = .673$, $SD = 0.153$), $t(31) = 6.38$, $p < .001$, regardless of condition. Results from both the salience and training trials indicated that the interesting object was indeed more attractive across these conditions (Figure 9).

In the test trials, did infants in the coincident trial respond like those in the conflict condition? Data for the test trials were analyzed in a 2 (condition) $\times$ 3 (test trials: original label, new label, recovery) repeated measures ANOVA. Data from the two trials that comprised the original-label test trials were averaged. There was no main effect of condition, test trial, and no interaction between test trial and condition ($p > .05$). Thus, the data were collapsed across conditions.

Unlike Study 1, we did not find a main effect of test or a quadratic pattern of looking time across the four test trials. That is, the children did not meet the strongest test for word learning. Did they, however, meet the weaker test by attaching the label to the interesting object? Yes. Three one-sample t tests comparing infants' looking times with a chance value of .50 were conducted. These tests indicated that infants looked significantly longer at the interesting object during the original-label test trials, $t(31) = 2.05$, $p < .05$, but did not have a preference for either object during the new-label and recovery trials, $t(31) = 1.21$, $p > .05$ and $t(31) = 1.58$, $p > .05$, respectively. Figure 10 illustrates the looking times across these trials. In the original or first two test trials, 23 of 32 (sign test; $p < .05$) children looked longer at the interesting object regardless of the side on which the interesting object was placed.

Discussion

Study 2 was conducted to see if 10-month-olds continued to show a mapping from word to object in

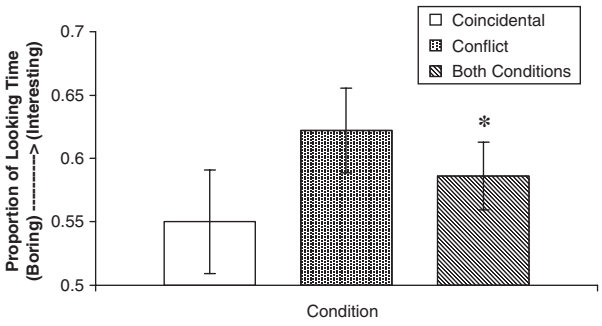

Figure 8. Infants' looking times during the salience trial. $^{*}p < .05$.

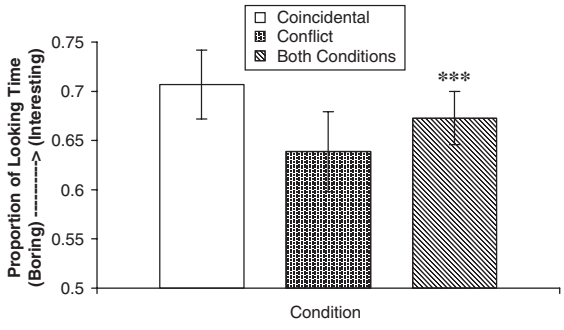

Figure 9. Infants' looking times during the training trial. $^{***}p < .001$.

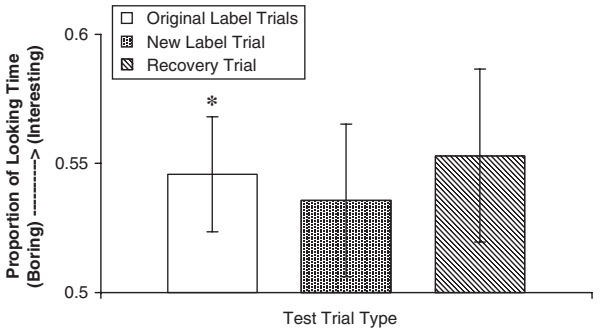

Figure 10. Infants' looking times across the three test trials:original label, new label, and recovery. $^{*}p < .05$.

a more challenging task. Here the locations of the interesting and boring objects were switched from saliency and training trials to the test trials. Switching the sides of the objects had an effect on the children, but there was a high degree of variability in infants' responses because this task was decidedly more difficult than that presented in Study 1. In the original-label test trials, children continued to show a preference for the interesting object—even when it changed sides. Thus, infants apparently assumed that the novel word was related to the interesting object. On the new-label trial, they showed a dampened response to the interesting object, looking away from it. However, in this more taxing test, infants did evidence a kind of mutual exclusivity; they also did not recover their looking to the original object when they again heard the original label. This should come as no surprise as even 19-month-olds have difficulty when the side of the object is switched at test (Hollich et al., 2000). What this finding does secure is that infants at 10 months of age did attach the word to the interesting object rather than to the spatial location of the object. If all they were learning was to pay attention to the side, they should not have followed the interesting object when it was switched to the other side. This study then clearly rules out the competing hypothesis that the children in Study 1 were only responding to or labeling the side of the object rather than the object itself. Infants are not labeling spatial location. Nonetheless, spatial location did play some minor role in infant processing because shifting that location did impact upon infants' final responses during the test trials.

General Discussion

These experiments asked three questions. First, will 10-month-olds show evidence of word learning in an interactive preferential looking paradigm (Hollich et al., 2000)? Second, will they use perceptual salience or social cues—like their elder peers—to map words? If they are insensitive to social cues, it would mean that they are not yet recruiting social intent for word learning. Third, if 10-month-olds do not use social cues but only perceptual salience, will they map words onto objects that are perceptually interesting to them, even if this results in a mismapping?

The results suggest that infants are learning words or are at least mapping words onto perceptually salient objects in their environment. This result emerged in the test trials of Study 1 in a very stringent test of word learning and was confirmed in the results of Study 2. Infants are linking words with objects that are of interest to them. This is consistent with other findings in the literature suggesting that when parents label objects that their children are already attending to, children learn the words more readily than when they label objects that are not as interesting to the child (Dunham, Dunham, & Curwin, 1993). It was also interesting that infants seemed to have a primitive sense of mutual exclusivity at 10 months. Although this only appears in tasks that are less demanding (e.g., Study 1), it is the first evidence that children younger than 18 months of age might be using this word-learning strategy (Markman et al., 2003).

The present studies not only speak to the power of a child's interest in guiding the word-learning process, but also to the fact that in the first year of life, children are apparently not yet recruiting social information to assist them in word learning. In Study 1, children were mildly sensitive to the social cue of eye gaze in training. However, even in training, attention to the speaker's gaze was not sufficient to command looking toward a boring object. These results offer strong evidence that children in the first year of life can map a word onto a referent, but do so primarily through the use of perceptual salience. Infants attach labels to what they find interesting and not to what the speaker is naming, responding differently than their older counterparts (Hollich et al., 2000). This is a building block for word learning, but does not demand that the children actually label the toy or use socially mediated information to determine which toy receives the label. Hence, 10-month-old infants can attend to certain social cues, but still fail to utilize those cues to assist in word learning. Here we find exactly this result. Infants are not using social intent to guide their word mapping.

As we have shown, when infants use a perceptual strategy for word learning, they are at risk for mismapping words. The 12-month-olds in the conflict condition in the Hollich et al. (2000) study noticed

the social cues, were lured by the perceptual cues, and became caught in the divide between word-mapping strategies. For this reason, they failed to attach the label to either object when the boring object was named. However, the 10-month-olds in this study did not avail themselves of the social cues at all. For them, the label went with the more interesting object—regardless of training condition. In the short run, such a strategy will assist children in learning a handful of words. Given that all speech is not about the ''here and now'' and is not attuned to the child's focus of attention, however, this strategy will ultimately lead to a number of mismappings.

The present finding that 10-month-olds learn words and do so through perceptual salience is controversial. As Woodward et al. (1994) noted with respect to their findings, ''This leads us to confront the most fundamental of questions about early word learning: what counts as a word?'' (p. 564). Did infants in this task engage in word learning at all? If a label merely ''goes with'' an object, can it be said to have the status of a word? Answers to this question distinguish between the mechanistic and social-pragmatic views of word learning. To the mechanist, these associates are words (Smith, 1995, 2000); to the social-pragmatist, these associates lack word status (Akhtar & Tomasello, 2000).

What should count as a word? In word production, the answer is clear. Children have a word when it is (a) used with the intention to communicate, (b) has a consistent phonological shape, (c) has a consistent meaning, and (d) is extended to multiple exemplars (Golinkoff & Hirsh-Pasek, 1999). In the area of comprehension, what counts as a word is less certain. Recent research on a border collie named Rico brings this question to the forefront. Kaminski, Call, and Fischer (2004) report on a dog that appears to have a comprehensive vocabulary of at least 200 words. When tested in an experimental paradigm, Rico was able to retrieve the appropriate referent of a label over 90% of the time. Should we count Rico's learning of these labels as true ''word learning?'' Markman and Abelev (2004) argue that Rico is engaging in associative learning rather than true word learning. Further, Bloom (2004) accounts for Rico's learning as a process of associating commands with ''object-specific desired actions.''

At 6 months of age, Tincoff and Jusczyk (1999) found that babies attached the words ''mommy'' and ''daddy'' to their own mothers and fathers rather than to other babies' parents. Do these children have words? Forming associations between words and referents is at least a precursor to learning words through the use of social intent. Oviatt (1980, 1982) suggests that an early comprehension of words, what she calls ''recognitory comprehension,'' is akin to forming an association between a linguistic form and a co-occuring referent. Only later are children able to break away from this association between word and referent and begin to understand that the word stands for the object in what she calls ''symbolic comprehension.'' Similarly, Werker et al. (1998) are sensitive to this same issue when they refer to word learning as ''word–object associations.'' According to Werker et al., true word learning occurs only when children can detach the word from the object, use it in a symbolic sense, and extend a label to other category members. Furthermore, Schafer (2005) suggests that even in comprehension, word status is tied to the ability to extend a word to new instances of the category. Indeed, he finds that by 12 months of age, children can do this in comprehension. And consider the case of the child with autism. The fact that children with autism, unable to compute social intent, can learn and extend new words in a comprehension task (Hennon, 2002) suggests that word learning does indeed occur without relying on the speaker's social intent. Our study did not address the issue of extension but rather of mapping. Mapping a word to a specific object (by whatever means) is surely the beginning of word learning. For some children (e.g., children with autism), this may be the best that they can do (Hennon, 2002). Yet, theoretical debates abound on just when a mapping between label and referent is in fact a word (Deacon, 1997).

Perhaps instead of asking whether one strategy yields word learning and the other preword learning, word learning develops along a continuum. One end might be anchored by the learner who uses association between perceptually salient objects and sounds to link word and referent from his point of view, the other end by the learner who uses social intent to map word to referent from the speaker's point of view. Under this scenario, our data offer a rapprochement between competing theories of word learning. At 10 months, infants are not sensitive to social intent and learn words associatively. A little further along the continuum, 12-month-olds (Hollich et al., 2000) are sensitive to social cues but cannot recruit them for word learning. Yet, 12-month-olds have advanced relative to their younger counterparts: They do not mismap the label for the boring toy to the interesting toy. Completing the continuum are the 1.5–2-year-olds who have mastered the process of word learning and use the social intent of the speaker to attach a label to the boring object (Hollich et al., 2000). The oldest group, now word-learning experts, can even rely on indirect, nonos-

tensive information for rapid word learning (Golinkoff, Hirsh-Pasek, Bailey, & Wenger, 1992). This continuum captures the word-learning process as described by the emergentist coalition model (Hollich et al., 2000) in a way that is consistent with a dynamic systems approach (Smith & Thelen, 1993). Where as infants have access to multiple cues for word learning (e.g., perceptual and social), the weight given to these cues shifts across development (Thelen & Smith, 1994).

Although such a theory unites seemingly disparate views, it begs the question of how the perceptually driven 10-month-old becomes the socially aware 19-month-old. One interesting possibility is that somewhere between the end of the first year and the middle of the second year, infants develop a primitive theory of mind (Wellman & Phillips, 2001), recognizing people as intentional beings (Gergely, 2003; Gergely et al., 1995; Woodward, Sommerville, & Guajardo, 2001). For example, at that time, they imitate an adult's incomplete, but intended actions (Meltzoff & Brooks, 2001), use social referencing to guide their behavior (Baldwin & Tomasello, 1998), treat adults as autonomous beings to be contacted through vocalizations (Harding & Golinkoff, 1979), and point for others' benefit (Butterworth & Grover, 1990). Once infants understand other beings as intentional, they can recognize the relevance of those intentions for learning words.

This shift from perceptual to socially influenced word learning may also explain why early word learning (at least production) is so slow (1–2 words per week) relative to the fast-paced learning that occurs after 19 months of age. If 10-month-old infants begin associatively, they may require repeated word-to-referent pairings. Single trial word learning, also called ''fast mapping'' (Carey & Bartlett, 1978), should be rare. Furthermore, associative learning will leave infants with wrong names to unlearn. An incorrect name can co-exist with a correct name for some time (Banigan & Mervis, 1988). The pace of word learning cannot accelerate until the ability to detect and utilize social cues in the word-learning situation comes ''on-line.'' That pace changes when infants realize that social information does not just guide attention but reflects the speaker's intention. Once children can use these cues to infer a speaker's labeling intent, they reduce the necessity to hear repeated pairings and no longer make as many word-learning errors.

Words are born of perceptually salient associations and not from sensitivity to social intent. Studying infants at the very beginning of the process reveals how word learning is transformed. These data also suggest the possibility that infants whose lexicons are delayed may rely on associative cues longer than their peers who shift to relying on social cues. These findings may also help explain the slow word learning in clinical populations who do not have sufficient sensitivity to social intent. Recently, for example, Hennon (2002) showed that children with autism, who often have difficulty using social cues, might have word-learning disturbances for this reason.

Conclusions

Although the pathway to early vocabulary must eventually be paved with social input (Morales, et al., 2001), it does not start out that way. These studies provide the first examination of the process of word learning in 10-month-old infants. Taken together with prior research (Hollich et al., 2000), these data suggest that the process of word learning undergoes a developmental shift. As infants rely less on their own perspective, they move from learning words associatively to learning words based on the social cues a speaker emits.

References

Adamson, L. (1995). *Communication development during infancy*. Madison, WI: Brown and Benchmark.

Akhtar, N., & Tomasello, M. (1998). Intersubjectivity in early language learning and use. In S. Braten (Ed.), *Intersubjective communication and emotion in early ontogeny* (pp. 316–335). Cambridge, UK: Cambridge University Press.

Akhtar, N., & Tomasello, M. (2000). The social nature of words and word learning. In R. M. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. Smith, A. Woodward, N. Akhtar, M. Tomasello, & G. Hollich (Eds.), *Becoming a word learner: A debate on lexical acquisition* (pp. 115–135). New York: Oxford University Press.

Baldwin, D. A. (1991). Infants' contribution to the achievement of joint reference. *Child Development*, *62*, 875–890.

Baldwin, D. A., & Markman, E. (1989). Establishing word–object relations: A first step. *Child Development*, *60*, 381–398.

Baldwin, D. A., Markman, E. M., Bill, B., Desjardins, N., Irwin, J. M., & Tidball, G. (1996). Infants' reliance on a social criterion for establishing word–object relations. *Child Development*, *67*, 3135–3153.

Baldwin, D. A., & Tomasello, M. (1998). Word learning: A window on early pragmatic understanding. In E. V. Clark (Ed.), *Proceedings of the Stanford Child Language Research Forum* (pp. 3–23). Stanford, CA: Center for the Study of Language and Information.

Banigan, R. L., & Mervis, C. B. (1988). Role of adult input in young children's category evolution: II. An experimental study. *Journal of Child Language*, *15*, 493–504.

Benedict, H. (1979). Early lexicon development: Comprehension and production. *Journal of Child Language*, *6*, 183–200.

Bloom, P. (2000). *How children learn the meanings of words*. Cambridge, MA: MIT Press.

Bloom, P. (2004). Can a dog learn a word? *Science*, *304*, 1605–1606.

Butterworth, G., & Grover, L. (1990). Joint visual attention, manual pointing, and preverbal communication in human infancy. In M. Jeannerod (Ed.), *Attention and performance XIII* (pp. 605–624). Hillsdale, NJ: Lawrence Erlbaum & Associates.

Carey, S., & Bartlett, E. (1978). Acquiring a single new word. *Papers and Reports on Child Language Development*, *15*, 17–29.

Carpenter, M., Nagell, K., & Tomasello, M. (1988). Social cognition, joint attention, and communicative competence from 9- to 15-months of age. *Monographs of the Society for Research in Child Development*, *63* (4, Serial No. 255).

Deacon, T. W. (1997). *The symbolic species: The co-evolution of language and the brain*. New York: W.W. Norton.

Dunham, P. J., Dunham, F., & Curwin, A. (1993). Joint-attentional states and lexical acquisition at 18 months. *Developmental Psychology, 29*, 827–831.

Fagan, J. (1971). Infant recognition memory for a series of visual stimuli. *Journal of Experimental Child Psychology, 11*, 244–250.

Fenson, L., Dale, P., Reznick, S., Bates, E., Thal, D., & Pethick, S. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, *59* (Serial No. 242).

Gergely, G. (2003). What should a robot learn from an infant? Mechanisms of action interpretation and observational learning in infancy. *Connection Science*, *15*, 191–209.

Gergely, G., Nadasdy, Z., Csibra, G., & Biro, S. (1995). Taking the intentional stance at 12 months of age. *Cognition*, *56*, 165–193.

Gogate, L. J., & Bahrick, L. E. (1998). Intersensory redundancy facilitates learning of arbitrary relations between vowel sounds and objects in seven-month-old infants. *Journal of Experimental Child Psychology, 69*, 133–149.

Golinkoff, R. M., & Hirsh-Pasek, K. (1999). *How babies talk: The magic and mystery of language development in the first three years of life*. New York: Penguin, Dutton.

Golinkoff, R. M., Hirsh-Pasek, K., Bailey, L., & Wenger, N. (1992). Young children and adults use lexical principles to learn new nouns. *Developmental Psychology, 28*, 99–108.

Golinkoff, R. M., Hirsh-Pasek, K., & Hollich, G. (1999). Emergent cues for early word learning. In B. MacWhinney (Ed.), *The emergence of language* (pp. 305–331). Mahwah, NJ: Lawrence Erlbaum & Associates.

Harding, C. G., & Golinkoff, R. M. (1979). The origins of intentional vocalizations in prelinguistic infants. *Child Development*, *50*, 33–40.

Hennon, E. A. (2002). How children with autistic disorder use attentional and intentional social information for word learning. Unpublished manuscript, Temple University.

Hennon, E. A., Maguire, M. J., Sootsman, J., Hirsh-Pasek, K., & Golinkoff, R. M. (In preparation) From proper nouns to categories: Infants learn how words work.

Hirsh-Pasek, K., Golinkoff, R. M., Hennon, E. A., & Maguire, M. J. (2004). Hybrid theories at the frontier of developmental psychology: The emergentist coalition model of word learning as a case in point. In D. Geoffrey Hall & S. R. Waxman (Eds.), *Weaving a lexicon* (pp. 173–204). Cambridge, MA: MIT Press.

Hirsh-Pasek, K., Golinkoff, R. M., & Hollich, G. (2000). An emergentist coalition model for word learning: Mapping words to objects is a product of the interaction of multiple cues. In R. M. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. B. Smith, A. L. Woodard, N. Akhtar, M. Tomasello, & G. Hollich (Eds.), *Becoming a word learner: A debate on lexical acquisition* (pp. 179–186). New York: Oxford University Press.

Hollich, G., Hirsh-Pasek, K., & Golinkoff, R. M.With Hennon, E., Chung, H. L., Rocroi, C., Brand, R. J., & Brown, E. (2000) . Breaking the language barrier: An emergentist coalition model for the origins of word learning. *Monographs of the Society for Research in Child Development, 65*, (3, Serial No. 262).

Kaminski, J., Call, J., & Fischer, J. (2004). Word learning in a domestic dog: Evidence for ''Fast Mapping''. *Science*, *304*, 1682–1683.

Markman, E. M. (1989). *Categorization and naming in children: Problems of induction*. Cambridge, MA: MIT Press.

Markman, E. M., & Abelev, M. (2004). Word learning in dogs? *Trends in Cognitive Science*, *8*, 479–481.

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.

Meltzoff, A. N., & Brooks, R. (2001). ''Like me'' as a building block for understanding other minds: Bodily acts, attention, and intention. In B. F. Malle, L. J. Moses, & D. A. Baldwin (Ed.), *Intentions and intentionality* (pp. 171–192). Cambridge, MA: MIT Press.

Moore, C., Angelopoulos, M., & Bennett, P. (1999). Word learning in the context of referential and salience cues. *Developmental Psychology, 35*, 60–68.

Morales, M., Mundy, P., Delgado, C. E. F., Yale, M., Messinger, D., Neal, R., et al. (2001). Responding to joint attention across the 6- through 24-month age period and early language acquisition. *Journal of Applied Developmental Psychology, 21*, 283–298.

Morales, M., Mundy, P., & Rojas, J. (1998). Following the direction of gaze and language development in 6-month-olds. *Infant Behavior and Development*, *21*, 373–377.

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.

Oviatt, S. L. (1980). The emerging ability to comprehend language: An experimental approach. *Child Development*, *51*, 97–106.

Oviatt, S. L. (1982). Inferring what words mean: Early development in infants' comprehension of common object names. *Child Development*, *53*, 274–277.

Samuelson, L. K., & Smith, L. B. (1998). Memory and attention make smart word learning: An alternative account of Akhtar, Carpenter, and Tomasello. *Child Development*, *69*, 94–104.

Schafer, G. (2005). Infants can learn decontextualized words before their first birthday. *Child Development*, *76*, 87–96.

Smith, L. B. (1995). Self-organizing processes in learning to learn words: Development is not induction. In C. A. Nelson (Ed.), *The Minnesota Symposia on Child Psychology* (Vol. 28, pp. 1–32). New York: Academic Press.

Smith, L. (2000). Learning how to learn words: An associative crane. In R. M. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. B. Smith, A. L. Woodard, N. Akhtar, M. Tomasello, & G. Hollich (Eds.), *Becoming a word learner: A debate on lexical acquisition* (pp. 51–80). New York: Oxford University Press.

Smith, L., & Thelen, E. (1993). *A dynamic systems approach to development: Applications*. Cambridge, MA: MIT Press.

Snow, C. (1999). *Social perspectives on the emergence of language*. Mahwah, NJ: Lawrence Erlbaum & Associates.

Tamis-LeMonda, C. S., Bornstein, M. H., Baumwell, L., Kahan-Kalman, R., & Cyphers, L. (1998). Predicting variation in the timing of linguistic milestones in the second year: An events history approach. *Journal of Child Language*, *25*, 675–700.

Thelen, E., & Smith, L. (1994). *A Dynamic Systems Approach to the development of cognition and action*. Cambridge, MA: The MIT Press.

Tincoff, R., & Jusczyk, P. W. (1999). Some beginnings of word comprehension in 6-month- olds. *Psychological Science*, *10*, 172–175.

Tomasello, M. (1992). The social bases of language acquisition. *Social Development*, *1*, 67–87.

Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.

Tomasello, M., & Call, J. (1997). *Primate cognition*. New York: Oxford University Press.

Tomasello, M., & Farrar, J. (1986). Joint attention and early language. *Child Development*, *57*, 1454–1463.

Waxman, S., & Booth, A. (2003). The origins and evolution of links between word learning and conceptual organization: New evidence from 11-month-olds. *Developmental Science*, *6*, 128–135.

Wellman, H. M., & Phillips, A. T. (2001). Developing intentional understandings. In B. F. Malle, L. J. Moses, & D. A. Baldwin (Eds.), *Intentions and intentionality* (pp. 125–148). Cambridge, MA: MIT Press.

Werker, J. F., Cohen, L., Lloyd, V., Casasola, M., & Stager, C. (1998). Acquisition of word object associations by 14-month old infants. *Developmental Psychology, 34*(6), 1289–1310.

Woodward, A. L., & Hoyne, K. (1999). Infants' learning about words and sounds in relation to objects. *Child Development*, *70*, 65–78.

Woodward, A. L., Markman, E., & Fitzsimmons, C. M. (1994). Rapid word learning in 13- and 18-month-olds. *Developmental Psychology, 30*, 553–556.

Woodward, A. L., Sommerville, J. A., & Guajardo, J. J. (2001). How infants make sense of intentional action. In B. F. Malle, L. J. Moses, & D. A. Baldwin (Eds.), *Intentions and intentionality* (pp. 149–169). Cambridge, MA: MIT Press.