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Examining the Role of Social Cues in Early Word Learning

by

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Examining the Role of Social Cues in Early Word Learning

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Infant word learning has become a popular field of study over the past decade. Research during this time has shown that infants can learn, in a short period of time, to attach words to objects. Two experiments on the role of social cues in early word learning are reported using tightly controlled conditions. Fourteen- and 18-month-old infants were trained by viewing a video of an adult pointing and nodding towards one of two different novel objects appearing on a screen simultaneously, while novel labels were emitted through a speaker. Infants' looking times to each object were recorded both during training and test trials. Our analyses indicated that both 14- and 18-month-olds looked significantly longer at the object that the adult pointed to in the training trials. However, only 18-month-olds showed any evidence of looking longer at the target object during the test in the consistent condition than in the inconsistent (control) condition. These studies are important because they show, in a controlled laboratory study of infant word learning, that different types of social cues are available at different ages. Fourteen-month-olds are aware of adult pointing and head turning and can follow those cues to an object during training. However, it isn't until 18 months of age that infants seem able to use those cues in the service of actual word learning.

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Infant word learning has become a popular field of study over the past decade. Research during this time has shown that infants as young as 14 months can learn, in a short period of time, to attach words to objects (e.g., Werker, Cohen, Lloyd, Casasola, and Stager, 1998; Shafer & Plunkett, 1998). By 18 months of age, infants are using a number of assumptions to aid them in the process of linking words to objects. Three of the assumptions infants use to organize their linguistic world are the “whole object” assumption, “mutual exclusivity,” and the “taxonomic” assumption. According to the whole object assumption, early word learners will attach a new label to a whole object, rather than to a part of that object (Markman, 1990); mutual exclusivity is the assumption that a child will assign a novel label to an object that the child does not already have a label for, rather than to an object for which the child has a label (Markman & Wachtel, 1988). Lastly, the taxonomic assumption is the notion that children will extend a new label to objects of the same kind, rather than objects that are thematically related to the known object (Markman, 1990). Children use these constraints as a way of minimizing the number of possible meanings for a given word. As Quine (1960) has pointed out in his *gavagai* example, there is an indefinite number of possible interpretations for any one item given the presentation of a label and its referent. In order for children to learn language, they must be able to pick out the correct interpretations for new words that they encounter when listening to others’ speech.

However, these cognitive constraints thought to be used by early word learners are not the only possible ways of assigning meanings to new words. Infants and children are engaged in social interactions every day; these interactions are often how they are

introduced to new words. If infants were not exposed to social interaction during word learning and made associations because of co-occurrences between words and objects alone, patterns of error would surface in the way they interpret novel words (Baldwin and Moses, 2001). But word learning often occurs as part of a social interaction, and the learner's job is to pick up information from the speaker about her behavior and actions and the relevance of the speaker's words to those actions. Previous research has shown that infants use social cues to aid them in acquiring new words (e.g., Baldwin & Moses, 2001). However, there is little research that has examined the use of social cues by infants using tightly controlled experiments that eliminate possible confounds found in interactive settings, such as subtle experimenter manipulations. The purpose of the present studies is to evaluate findings of previous research examining referential intent and social referencing, but using a type of experiment that eliminates confounds associated with interactions between the infant and experimenter. Another goal of the present study is to examine different functions of these social cues to see if the attention directing aspect might be separate from the word-learning aspect.

Research reported during the past several years has shown that infants can learn to make word-object associations without the help of social cues in experimental settings. For example, infants as young as 13 to 14 months have been shown to be able to learn word-object associations in as little as 5 minutes (Werker, et al., 1998). Werker et al. conducted a series of six experiments using the "switch" design in which infants were habituated to two word-object pairings presented alternately (object A with word 1 and object B with word 2), and looking times for each trial were recorded. Infants were then

tested on two test trials. One test trial involved a familiar word-object pairing, and the other test trial involved a familiar word and a familiar object, but in a new pairing.

Werker et al. (1998) found that only 14-month old infants made the word-object associations, and seemed to do so only when the objects were moving. The infants tested from all age groups (8-, 10-, 12-, and 14-months) seemed able to process information about the word and object independently, but only 14-month-olds formed the association. Werker et al. (1998) suggested that the ability to associate words and objects could aid in language acquisition, which is a major advancement for infants at this age.

Schafer and Plunkett (1998) also found rapid word learning with 15-month-old infants using a preferential looking procedure. They trained infants with two novel labels paired with novel objects and then tested their knowledge of the labels. During some training trials, infants heard one of the two novel labels while a novel object appeared on a monitor. Other trials consisted of the second novel label with a different novel object appearing on the monitor (sides of presentation were counterbalanced). For the test phase, both novel objects appeared simultaneously, presented with an auditory stimulus. Infants' looking time to each object was recorded, and Schafer and Plunkett (1998) found that infants preferred to look at the images that matched the auditory stimuli they heard. This shows evidence of word learning by 15-month-old infants in a short period of time (less than five minutes).

However, one of the key issues in this whole area of research is the role of social cues. Central questions include just how important it is to have a person present when this learning occurs, and how critical it is that the person indicates to the infant that certain

words go with certain objects. Co-occurrences between words and objects occur for coincidental reasons in everyday situations. For example, an infant might be playing with a toy at the same time words are being spoken on the television. If an infant hears the same word more than once while playing with the toy, he might come to associate the word with that toy. But if the infant understands that the speaker on television has no intention of labeling the object to which he is attending, he could avoid these types of errors.

Another issue imbedded in the questions listed above is establishing the difference between social referencing and referential intent. Social referencing is the idea that infants will look to parents or other adults when in a novel situation to seek information about how to respond to the situation (e.g., Sorce, Emde, Campos, & Klinnert, 1984, as cited in Baldwin & Moses, 1996). A critical component of social referencing is that a child needs to possess social understanding: that is, an understanding that when people use language, facial expressions, emotion and/or social cues, they provide clues about something of interest or reference (e.g., Searle, 1983, as cited in Baldwin and Moses). Referential intent, on the other hand, is an adult's intention to direct attention towards an object of interest using social cues such as pointing, head turning, and eye gaze; these are some of the social cues that several researchers have used to study social factors in infant word learning (e.g., Baldwin, 1991; Moore, Angelopoulos, & Bennet, 1999). Some may think that words in general could be considered social cues for language learning because language itself is social in that it is a way in which humans communicate with one another. However, studies that use only words to refer to objects

(with no other social cues present) are often not considered as studies addressing social referencing. For purposes of the present study, both studies addressing social referencing as well as referential intent will be discussed.

Some researchers claim that social cues are important, if not necessary, for learning language (e.g., Baldwin, Markman, Bill, Desjardins, Irwin, & Tidball, 1996) and that infants understand the referential role of the speaker (Koenig & Echols, 2000). According to Baldwin et al. (1996), infants are more likely to link a word to an object if they think the speaker is referring to that object when speaking. In their study, infants aged 18-20 months (but not 15 months) established a link between a word and a target object only when the speaker who labeled the object was within view of the infant and displayed attention towards the target object while labeling it. If the speaker was out of view of the infants, then infants appeared to make no association between the object and its label.

Another such study examining the importance of referential and salience cues in infant word learning found that both 18- and 24-month old infants were able to acquire novel labels in a joint attention task, and infants of both ages could follow an adult's referential cue to a target object (Moore, Angelopoulos, & Bennett, 1999). Moore et al. tested both 18- and 24-month old infants in four conditions. In the "match" condition, infants were presented with two novel toys and heard a novel label. The experimenter turned her head to one object (the target) while saying the label on three of the trials, and turned her head to the other object (the nontarget) while referring to it using a pronoun (instead of a label) on another three trials. The object that the experimenter turned to also

moved while she was attending to it, whereas the nontarget remained static. During the “mismatch” condition, the infants were presented with the same stimuli, but the attended-to object was in conflict with the moving object (the target remained static while the nontarget moved, so referential intent conflicted with salience). In the first of two control conditions, both objects moved as the experimenter labeled one; in the other control condition, both objects remained static the whole time.

Moore et al. (1999) found that both 18- and 24-month old infants could follow an adult’s intent to refer to a target object and both were able to acquire novel labels in the joint attention task. Infants at both ages choose significantly more often the target toy in the match condition and in both control conditions. However, if there was conflict between referential cues and salience cues (as in the mismatch condition), then only 24-month-olds could choose the correct object significantly more often than chance. The 18-month-olds looked equally often at the two presented toys in the mismatch condition, which the researchers concluded meant that they were equally drawn by the salience of the toys and by the adult’s referential intent. On the other hand, when only salience cues were present without referential cues, then 18-month-olds did not acquire novel labels, thus indicating that there is a need for referential behavior by an adult in order for these younger infants to learn the novel words. The findings of these last few studies indicate that referential intent and social understanding are important components in language development.

But, evidence also exists that show infants can learn word-object associations without social cues (e.g., Shafer & Plunkett, 1998; Werker, et al., 1998). Even though

there is a disagreement among researchers, most people would say that social cues are helpful. However, the question is still open about the specific ways social cues may be beneficial. For example, referential intent cues could promote language learning by keeping the infant's overall attention level high, or the benefits could be more specific in that they help infants learn that certain words go with certain objects.

Another issue that needs to be addressed is how cues such as pointing and gaze are used by caregivers and infants in everyday situations. Maternal gestures were examined with mothers of 20-month-old infants in both a free-play task and a count task (O'Neill, Bard, Linnell, & Fluck, 2005). Findings are consistent with past research in that mothers most often employed deictic gestures, with the most frequently used gesture being pointing. The mothers in this study were English, but the same was found in studies with American and Italian subjects (Iverson, Capirci, Longobardi, & Caselli, 1999; Schmidt, 1996 as cited in O'Neill, et al.). The gestures were mainly used to disambiguate accompanying verbal speech (i.e., to identify the referent of an utterance). Even when engaging in the free-play session, mothers most often read to her child, thus engaging in an instructional interaction (which was the same type of interaction as the count task). Thus, the researchers concluded that mothers most often use deictic gestures (specifically pointing), along with speech, to 'teach' word-object relations to their children in these types of interactions.

Furthermore, in a cross-cultural study using English-Canadian, Parisian-French, Japanese, and Italian-Canadian infants, the gestural repertoire of infants was examined across different ages (Blake, Vitale, Osborne, & Olshansky, 2005). It was found that

almost all groups increased their use of comment gestures, particularly pointing, over time. Also, declarative pointing was one of the most common gestures used among the groups. Other gestures that increased over time were object exchange gestures and agency gestures; all three of these types of gestures were also found to be positively related to vocabulary acquisition, particularly receptive vocabulary. The researchers suggested that the infant gestural repertoire is universal, and any infrequencies found among groups are due to differential experience, more specifically, parental input.

Another important aspect of language learning is what infants and children do and do not understand about reference and social cues. Moll and Tomasello (2004) examined whether infants understand that the looking behavior of others is an act of seeing (i.e., that others can see objects of interest, even if the infants themselves cannot see the objects). They conducted a study in which adults looked behind a barrier that blocked the child's line of view. They wanted to find out what children would do when they could not see what the adult was seeing. Would the children move their position in order to get a better view, or would they not understand that moving to look around the barrier would allow them to see what the adult was looking at? According to Moore and Corkum (1998), it is not until infants are 18 months of age that they are able to understand the referentiality of looking behaviors. Using the Eye Status paradigm, in which an experimenter looked to a specific location either by 1) moving both head and eyes, 2) moving only the head, or 3) moving only the eyes, they concluded that only 18-month-old infants (not younger infants) followed the experimenter's eye movements. However, other researchers (e.g., Caron, Butler, & Brooks, 2002; Brooks and Meltzoff, 2002) used

a modified version of the Eye Status paradigm previously used by Moore and Corkum and found different results. Brooks and Meltzoff (2002) found that 14-month-old infants were influenced by eye movements, following gazes more when the experimenter had open eyes than when either the experimenter's eyes were closed or covered by a blindfold. Moll and Tomasello (2004) used a variation of the Barrier paradigm to study the gaze-following behavior of infants. In their version, the children's line of vision was blocked by a barrier, so if the children wanted to see what the experimenter was seeing, they would have to 1) understand that the adult was looking at something behind the barrier that they themselves could not see, and 2) locomote to a new location in order to gain a better viewing angle. They found that both 12- and 18- month old infants were able to do these two things. They either crawled or walked a short distance in order to look behind the barrier and see what the experimenter was seeing. This study presented evidence that infants understand that others see things, even when the infants themselves can't see the same things.

Most studies exploring referential intent and social understanding have shown that these social cues become advantageous at around 18 months of age, but they are not always useful for younger infants. Sodian and Thoermer (2004) investigated 12-month-old infants on their understanding of pointing, reaching, and gaze following cues to goal-directed actions. Infants at this age understood reaching/grasping and looking (but not pointing) as cues to goal-directed behavior in referential-intentional terms. They did find that infants were able to follow the pointing cues to specific objects, but they did not use the cues as an indication of future action (i.e., that the object would be picked up). Thus,

they argued that there is a developmental lag between infants' interpretation of reaching and grasping and their interpretation of pointing. They concluded that infants may have a harder time interpreting pointing than grasping because grasping involves physical contact with an object, whereas pointing does not. Furthermore, infants may first have to acquire some experience with pointing and use it themselves in a social manner in order to understand the intentional use of pointing when used by others. Once they understand that pointing can be used to direct others' attention to an object of interest, they can then understand the referential-intentional use of pointing by adults. However, Sodian and Thoermer's experiments included live actions, so movements and facial and emotional expressions were not tightly controlled, and utterances were not kept consistent throughout, which could have led to confounds in their study.

Behne, Carpenter, and Tomasello (2005) examined older infants' understanding of communicative intent and found that 14-, 18-, and 24-month old infants understand the communicative intent of adult pointing and eye gaze. The infants in their study followed communicative (but not non-communicative) eye gaze and pointing to reliably choose the correct box in which a toy was hiding. Also, children's search performance improved with increasing age, and it occurred earlier with the pointing cue than with the eye gaze cue. However, the pointing cue used in their study co-occurred with eye gaze, so the researchers cannot conclude that it was the pointing alone, as opposed to the combination of cues, that increased performance. In their control study, the experimenter also provided pointing and eye gaze cues, but they were non-communicative in manner (i.e., the experimenter extended her finger in the direction of the object while pretending to

look at her watch). The infants in this condition did not differ from chance when searching for the hidden toy. This illustrated that infants must not only be able to follow another person's gaze or point in order for it to be useful, but infants must also be able to infer that those cues are meant to be communicative for that particular interaction and that the cues are presented for their benefit. Infants at all three ages used both pointing and gaze cues to correctly guess the location of the hidden toy, and search performance improved with age.

In accordance with what appears to be a developmental trend in infants' use of pointing and eye gaze in a non-linguistic setting, some researchers have found there to be a developmental trend in the use of social cues to guide word learning as well. According to Hollich, Hirsh-Pasek, Golinkoff, Brand, Brown, Chung, et al. (2000) younger infants rely more on attentional cues, such as salience of objects, while older infants rely more on social cues for learning labels. They found that 12-month-old infants could follow the social cues of eye gaze, touching, and handling, but they were unable to use these cues to learn labels in an Intermodal Preferential Looking Paradigm (IPLP). Nineteen-month-old infants were sensitive to both perceptual salience and social eye gaze, but word learning was weak. The 24-month-old infants were most sensitive to social eye gaze, which enabled them to learn labels for objects. Infants of this age realized that social cues were more important for word learning than perceptual salience. Hollich, et al. (2000) concluded that the ability to successfully follow social cues to a target object is separate from the ability to attach a label to a target object.

However, there could be potential problems with these previous studies assessing social factors. The researchers have examined these factors during active social interactions between the experimenter and the infant. While there may be advantages to these types of designs in that they are more naturalistic with respect to the real world and infants' experiences and may generalize better to everyday situations that infants engage in at home, there are also disadvantages. Active social interactions between the experimenter and the infant are situations in which the experimenter knows what the infant should do and can subtly control the infant's behavior. These previous studies have all been loosely controlled and may have included many confounds. For example, the experimenter may inadvertently provide a more pleasing expression when an infant provides a correct response than when an infants displays incorrect behavior, which may influence what the infant does in subsequent situations. There is limited research on the influence of social cues on early word learning using tightly controlled experiments, which is the motivation of the present study.

The purpose of the experiments presented here is to examine the various mechanisms involved in social learning in experimental studies, in which videos are used to provide the stimuli rather than live interactions. Previous research has shown that infants understand that static images are representations of objects, and they can discriminate between real objects and depictions of objects (DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb, 1998). Particularly relevant to this study, prior research shows that infants can follow gaze information in videotaped images. In a study reported by von Hofsten, Dahlstrom, and Fredriksson (2005), 12-month-old infants were shown

static images from a video of a female adult seated behind a table with four objects positioned on either side of her. She either both looked and pointed at an object of interest, just looked at the object, or just pointed at the object while looking ahead. Infants' looking behavior was recorded using an eye-tracking device. Von Hofsten et al. found that infants looked significantly longer toward the side (but not necessarily the object) at which the adult looked or pointed. Further analyses revealed that infants did, indeed, look longer at the attended object than at the unattended objects on either side of the model. However, when pointing alone was used, infants did not look significantly longer at the indicated object. Nor did looking times increase when both pointing and gaze were used as opposed to gaze alone. The researchers concluded that infants could discriminate gaze direction from eye and head postures in static images, meaning live social interactions are not necessary for infants to follow social cues. The study reported here will build on this evidence of gaze following from videotaped stimuli to test word learning using videotaped referential intent cues.

One very recent series of studies that has explored word learning in a controlled experimental setting using digitally recorded social cues was reported by Houston-Price, Plunkett, and Duffy (2006). These studies were the first to demonstrate that infants can use social cues (specifically gaze direction) presented by an adult who is not physically present or interacting with the infants to learn labels for novel objects. In the first of their experiments, 15-month-old infants were presented with two objects (familiar but name-unknown) simultaneously on a projection screen. During the testing phase, which came before the training phase, infants were presented with the two still images and an auditory

label (looking time toward either side was recorded). During the training phase, the two images remained on the screen, the label was presented a second time, and a video image of an adult female face appeared on the screen between the images. The face looked briefly in the center toward the infant before turning to either her left or right side (which would indicate the target side). This procedure was repeated 12 times with the name-unknown images and for 6 trials with familiar images. The results indicated that 15-month-old infants were sensitive to the gaze direction presented by the adult (demonstrated by infants' gaze following), and they were able to use these cues to determine the correct referent for novel words. The rest of the experiments in this set of studies examined infants' use of salience cues (movement) in the context of word learning. Their results showed that infants made word-object associations based on movement, but they were more concerned about the *consistency* of movement rather than movement alone. For example, they were more likely to attach a label to an object that did not move during training because that object also did not move during the test; the movement (or lack thereof) was consistent 100 percent of the time, whereas the other object moved 50 percent of the time (during training) and was stationary during the other 50 percent (during test). As long as there was consistency in the visual scene, learning occurred with the majority of infants. However, when the social heard-turn cue conflicted with the image whose movement was consistent 100 percent of the time, no learning occurred.

There are some limitations to Houston-Price et al.'s (2006) studies because of the difficult nature of them. For example, in the way the experiments were set up, the testing

phase was presented before the training phase in each trial, so that, according to the researchers, they could be confident in their interpretation of the results (i.e., since it was presented in a test-training design, infants' behavior could not have been influenced by what they attended to in the training phase). But, it is not necessary to employ this complicated procedure in order to get reliable results. If all testing trials were presented at the end after all training trials (after being exposed to both labels), then that problem could be avoided. Another potential problem with these studies is that the target objects in the images they used were not obvious. The images were embedded within a still image taken from a scene in the children's program *Teletubbies*. Because the objects were part of a larger picture, it is hard to conclude that the infants were attaching the labels to their actual referents and not to something else within the scene. Furthermore, even though Houston-Price et al. found that the infants looked significantly longer at the target object during test, they only fixated the target image an average of 52% of the time, a relatively weak finding.

Because studying social cues in the context of word learning using tightly controlled procedures is relatively new, it is important to determine the age at which these cues start to be useful. One purpose of the present study is to see if 14-month-old infants (the age at which infants have been shown to make word-object associations, but younger than the age at which word learning was found using a controlled procedure with social cues) could take advantage of social cues presented to them. Infant looking times in the present study were recorded while infants looked at various stimuli presented on a plasma screen television monitor. A preferential looking procedure was employed,

testing 14- and 18-month-old infants under two conditions. In the first condition, infants were trained by viewing a video of an adult pointing and nodding towards two different novel objects while novel labels were emitted through a speaker. In this condition the adult labeled the object consistently, so that the same word was used to label one object and a different word was used to label the second object. In the second condition, infants viewed similar videos, but the adult labeled the objects inconsistently, so that no learning should occur under this condition. In the test trial, the adult was on the screen with the objects, but she was not employing any referential intent cues (i.e., she was stationary in the center of the screen while labels were emitted through a speaker). Infants' looking times to each object were recorded. This method examines referential intent by providing infants with social cues for determining the referents associated with given labels; it also examines infants' social understanding by establishing whether infants' understand that social cues are provided to them for the purpose of referring to objects of interest and in the service of word learning.

Experiment 1

Method

Participants. Twenty-four 14-month-old infants (12 males and 12 females) participated in this study. They were all full-term and had no reported vision or hearing problems. The mean age of the participants was 13.8 months (range: 13.4 – 14.5 months). An additional 17 infants participated but were excluded for the following reasons: they became fussy or were not attentive (looked at the stimuli < 25% of the time during the test phase; n=6), they had a side preference (n=7), the infant's eyes were not

visible for part of the time ($n=4$). The majority of the infants were Caucasian (83%) and most mothers had at least some college (96%). Participants were recruited in Austin, TX and surrounding areas through birth records from the Texas Department of Health. After sending an introductory letter through the mail inviting parents to participate, they were contacted by telephone. Those who took part in the experiment were offered a small gift (a t-shirt, a bib, or a sippy cup) for their participation.

Stimuli. Stimuli for this study consisted of two pictures of single novel objects simultaneously rotating on either side of a 42" plasma screen television against a uniform gray background. One object was a green and yellow striped rectangular block with four yellow rings extending from each side that measured approximately 5" x 6" (refer to Figure 1). The other object was a red and black striped "hat" with needles sticking vertically from the top, which measured approximately 4" x 6". In the center of the screen was a movie (measuring 10" x 12") of a Caucasian female adult pointing and shifting attention toward one of the two objects while an audio word file played in the background. Movie-making software was used to make QuickTime movies in which the pictures of objects were positioned on either side of the center movie to create one complete movie.

Each movie was paired with one of two auditory files, which consisted of three exemplars of a single nonsense word (*lif* or *neem*) spoken in infant-directed speech by a female native English speaker. Either "Look! Lif!" or "Look! Neem!" was presented three times during any one trial with the result that each word was presented a total of 18 times during the familiarization trials (i.e., training trials). These exemplars were also

presented three times during a test trial for a total of 6 presentations per word (i.e., one word was presented three times during each of two test trials, and the other word was presented three times during each of the other two test trials).

Apparatus. The testing session took place in a small, quiet, dimly lit testing room in the Children's Research Lab at the University of Texas at Austin. Infants were seated on the parent's lap facing the plasma screen approximately 42" away. A closed circuit television camera was positioned beneath the television, which allowed the experimenter seated in an adjacent room to monitor the infants' looking responses and to record the session for reliability purposes. The parents were asked not to interact with their infant and to close their eyes during the experiment so they would not be able to see the stimuli during the testing session (thus eliminating any subtle cues or interaction between parents and infants).

The experimenter presented the stimuli on a PowerMac G4 using the habituation program, HabitX (Cohen, Atkinson, & Chaput, 2000). She observed the session on a television monitor in an adjacent observation room, recording infants' direction and duration of gaze towards the stimuli by pressing preprogrammed keys (one for left looks and one for right looks) on a computer keyboard when the infant looked at the stimuli, and releasing the key when the infant looked away. Before each trial, which lasted 11 seconds, an attention-getter (which consisted of an expanding green circle against a black background accompanied by a ringing bell) was presented in the center of the screen to capture the infant's attention. Once the infant looked at the screen again, the experimenter pressed a different key to start the next trial. The experimenter was blind to

the side to which the target object was presented. Each subject was recorded with a DVD player for reliability purposes.

Procedure. Upon their arrival, parents were briefed on what to expect during their session, and consent was requested by the experimenter after answering any questions the parent may have had. Participants were led to the study room and the parent was seated facing the television monitor with the infant on her lap. Each parent was again reminded not to interfere with her infant during the task.

Infants were tested in a variation of the “preferential looking” paradigm with a familiarization phase and a test phase. During the familiarization phase, infants viewed stimuli (one on the left and one on the right) presented simultaneously on a plasma screen television. Infants viewed two novel objects (one object acted as a distractor object and the other acted as the target object) paired with nonsense labels, with a video of an adult in the middle of the screen pointing and nodding towards the target object while labeling it (i.e., producing referential intent cues). Each infant was exposed to one of two familiarization conditions. Some infants heard nonsense words (“Look! Lif!” or “Look! Neem!”) consistently paired with the target objects. Others heard the same nonsense words, but they were paired inconsistently (across trials) with the target objects. For example, on one trial infants might have seen the female adult point to object A while the auditory stimulus “Look! Lif!” was emitted through the speaker, but on the next trial they might have seen the female point to the same object A but a different label (“Look! Neem!”) was heard. Therefore, the labels were inconsistent in relation to the target object. There were twelve 11-second familiarization trials, and the labels were presented

three times during each trial. After the familiarization phase, infants were given a test phase in which there were no social referencing cues (i.e., the speaker was motionless in the center of the screen looking directly to the front and infants heard, “Look! Lif!” or “Look! Neem!”). The labels were presented three times during each of four 11-second test trials. The presentation of the novel objects and the direction of pointing were counterbalanced across both familiarization and test trials.

A second observer viewed and coded each participant’s DVD to check for reliability of the original sessions. One-third of the infants were randomly chosen for reliabilities, and the inter-rater reliabilities were high ($r = .96$).

Results

Preference scores for the target object (the object that the female adult pointed to) were calculated for all four test trials as the percentage of looking time towards the correct side (looking time towards the correct side divided by total looking time). T-tests were run to determine whether infants’ looking time to the target object was significantly different from chance (.50). Overall looking time to the object that matched the auditory stimulus during all four test trials in the consistent labeling condition was not significant, $t(11) = .94$, $p = .37$, which suggests that the infants were not able to attach the labels to the objects (see Table 1 for means and standard deviations). Furthermore, as expected, looking time to the correct object during the inconsistent labeling condition was also non-significant, $t(11) = 1.38$, $p = .20$. The target object in this condition was selected arbitrarily, so that analyses of the data could remain consistent. In other words, one

object was picked to be the target, and looking time to that object was tested against chance to see if the infants looked longer at any one object, which was not the case.

T-tests were also performed to determine whether the amount of looking time towards the object to which the female adult pointed during familiarization trials differed significantly from chance (.50). For both the consistent condition, $t(11) = 3.79$, $p = .003$, and the inconsistent condition, $t(11) = 4.63$, $p = .001$, the infants looked significantly longer at the object to which the female pointed than the object not pointed to (refer to Table 2 for means and standard deviations). Furthermore, the overall main effect for looking times toward the target side for both conditions was significant, $t(23) = 6.03$, $p = .000$. These results suggest that the infants were not just responding randomly. They were aware of the adult's social cues, because they did, in fact, follow the direction of the pointing significantly more than expected by chance.

Discussion

Results show that no word learning is occurring using the social cues of pointing and head turning, but they suggest that the infants are *following* these social cues. In other words, the infants in both the consistent and inconsistent labeling conditions look more at the object that the female points to than the object that she does not point to, but in neither condition do the infants learn the labels.

As previous studies suggest (e.g., Hollich et al., 2000), the task demands may be too difficult for 14-month-old infants to master. The infants examined in this study seemed to be aware of the social cues, but they did not make use of them for word learning. It might be too difficult in an 11-second period for these younger infants to (1)

pick up on the social cues available, and (2) realize these social cues are necessary to learn the labels for the objects. Older infants, however, may have the cognitive capacity to do both.

Another possible explanation for why the infants did not learn labels for the objects is that the infants were not attentive enough to the social cues, even if they were aware of them. They might have been more interested in looking at the person in the middle of the screen, or they may have been so overwhelmed by the social cues that they were unable to process the meaning of them. Or, they may not have paid attention to the auditory stimuli, which would prevent them from being able to attach labels to the objects. Additional analyses need to be conducted to determine the likelihood of these possibilities.

In order to test whether the task was too difficult for these younger infants, a second study was conducted to examine 18-month-old infants using the same procedure as above. It was hypothesized that 18-month-olds would be able to learn the labels for the objects in the consistent labeling condition, but not in the inconsistent labeling condition. If older infants are able to learn under these procedures, then it would suggest that infants must exploit and coordinate multiple factors (i.e., noticing, attending to, and utilizing social cues) for word learning, that this ability develops over time, and that the ability to coordinate cues will distinguish beginning word learners from proficient word learners. Furthermore, if the results are as expected, then the use of social cues might reinforce the notion that infants use social information to aid them in rapid word learning,

also called the “naming explosion,” which starts to occur around 18 months of age (e.g., Bloom, 1973).

Experiment 2

Experiment 2 was conducted to determine if 18-month-old infants, unlike 14-month-olds, would be able to use social cues presented by an adult in a controlled experimental setting to their advantage in establishing a novel word-object link. Since the younger infants were not able to learn the labels for the novel objects, an obvious next step was to see if older infants could do so.

Method

Participants. Twenty-four 18-month-old infants (12 males and 12 females) participated in this study. They were all full-term and had no reported vision or hearing problems. The mean age of the participants was 18.1 months (range: 17.6 – 18.7 months). An additional 23 infants participated but were excluded for the following reasons: they became fussy or were not attentive (looked at the stimuli < 25% of the time during the test phase; n=10), they had a side preference (n=7), or the infant’s eyes were not visible for part of the time (n=6). The majority of the infants were Caucasian (92%) and all mothers had at least some college. Participants were recruited by the same methods used in Experiment 1.

Stimuli. The stimuli were identical to those presented in Experiment 1. Two pictures of single novel objects simultaneously rotated on either side of a screen against a uniform grey background. In the center of the screen was a movie of a Caucasian female

adult pointing and shifting attention toward one of the two objects while an audio word file played in the background.

Apparatus and Procedure. The location, apparatus, and procedure used for Experiment 2 were the same as those used for Experiment 1. One-third of the infants were randomly chosen for reliabilities, and the inter-rater reliabilities were high ($r = .96$).

Results

A comparison of each infant's looking time toward the target object (i.e., the object to which the female pointed during training) during the four test trials was performed in order to determine if the infants were taking advantage of the adult's social cues. T-tests were run to determine if the infants' preference scores towards the target object were significantly different from chance (.50). In the consistent labeling condition, infants' looking time to the object that matched the auditory stimulus during all four test trials was significant, $t(11) = 2.50$, $p = .03$, which suggests that 18-month-old infants were able to take advantage of the social cues provided by the adult and use them to attach the labels to the objects (refer to Table 1 for the means and standard deviations). Furthermore, as was predicted, infants did not look significantly longer than chance would predict at either of the objects presented during the inconsistent labeling condition, $t(23) = -1.08$, $p = .30$.

T-tests were also performed to determine whether the infants looked significantly longer than chance (.50) would predict towards the side that the female pointed to during the familiarization trials. For the consistent condition, looking time toward the target side approached significance, $t(11) = 2.07$, $p = .06$, and for the inconsistent condition, the

infants looked significantly longer towards the side that the female pointed to, $t(11) = 4.09$, $p = .002$, which further suggests that infants were aware of the social cues (refer to Table 2 for means and standard deviations). Additionally, the overall main effect for looking times toward the target side across conditions was significant, $t(23) = 4.20$, $p = .000$.

Discussion

The hypothesis that 18-month-old infants would be able to make novel word-object links using social cues presented by an adult in a tightly controlled experimental setting was supported by the data. As shown by the results, infants were able to learn novel labels for two novel objects in the consistent labeling condition, but not in the inconsistent labeling condition, which was expected. In the inconsistent labeling condition, because the labels and objects were not paired consistently across trials, it would not be possible for the infants to make any kind of association. Furthermore, because they did not look at one object longer than the other, this condition acts as a control in that it shows that one object is not preferred more than the other.

Even though results for the consistent labeling group did not quite reach significance for looking time towards the side that the adult pointed to during the familiarization trials, there was a trend for the infants to look in the target direction, and infants obviously received enough cues to attach the labels to the objects. Additionally, infants in the inconsistent labeling condition did look significantly longer towards the target side during training, which may suggest that they were seeking additional help in figuring out what the labels referred to, because they were not paired consistently with

the objects. The infants in this condition may have been confused, thus searching for more clues. Additional analyses need to be conducted to determine the importance of the person in the center of the screen.

These results are consistent with other word learning studies examining social referencing and referential intent that have shown that older infants, but not younger ones, use social cues for word learning (e.g., Baldwin, et al. 1996). Eighteen-month-old infants were able to both follow the social cues presented to them and use them to learn labels for novel objects. What is different about this study is that it found these results using a tightly controlled experimental procedure, so that any experimenter manipulations or outside influences were controlled. These 18-month-olds were able to pick up on the social cues, realize that they are helpful and informative, and use them to shift their gaze to a referent for the word that they heard—something the 14-month-olds could not achieve.

General Discussion

These two studies taken together suggest that social cues in the context of word learning are not yet advantageous for younger infants, but they might be useful for older infants. While 14-month-old infants in Experiment 1 were not able to attach the provided labels to novel objects, previous studies have shown that infants as young as 14 months old can make word-object associations without social cues (Werker, et al., 1998). However, because 18-month-olds were able to make the associations, social cues may be an additional aid for older infants when learning names for objects. The difference between the previous word learning studies and this one, however, is that in previous

studies only one object was presented to the infants during any one trial, so that there was no conflict with a second object that could serve as a potential referent. In these studies, two objects were presented during each trial, so the only way infants could learn the labels was if they took advantage of the social cues presented to them. An additional explanation for the naming explosion that occurs around 18 months of age could be that older infants (but not younger ones) are able to distinguish between non-social cues (such as words heard during a telephone conversation) and social cues presented to them in everyday situations, and only pay attention to the social cues for word learning.

There are several possibilities as to why 14-month-old infants did not learn the word-object associations when social cues were provided. One possibility is that the younger infants were not resourceful enough to use the social cues to their advantage. Goubet, Rochat, Maire-Leblond, and Poss (2006) explored infants' use of an adult as a source for help and instruction during problem solving tasks and found that older infants (14-18 months) used modeling cues to solve problems significantly more often than younger infants (9 months); the older infants used the experimenter's help more efficiently and consistently than did the younger ones. In other words, with regards to problem-solving tasks, 9 month-old infants were sensitive to modeling cues (but not resourceful), while 14-18-month olds were both sensitive to and resourceful in using modeling cues to help them solve problems that increased in complexity. As has been shown, 14-month-old infants in the present study were also sensitive to the social cues provided in that they followed the direction of pointing in the training trials, but perhaps they were not yet capable of using them for word learning. Furthermore, the fact that 18-

month-olds were able to learn the labels in this study is consistent with the view that sensitivity to social learning becomes more apparent as children get older.

The results presented here are also in accordance with Baldwin et al. (1996). In their study 18-20 month-old infants made word-object associations (when the experimenter was within view and attending to the target object), but younger infants (15-month-olds) did not make the associations. The researchers suggested that the experimental situation was too complex for the infants to understand and be able to make the links necessary for learning to occur. Furthermore, Hollich et al. (2000) found a developmental trend in children's ability to take advantage of social factors. As indicated by the researchers, it may be easier for older children to use eye gaze (the social cue in their studies) for word learning because they are more likely to understand the importance of social information in the environment. The younger infants in their study showed evidence of learning only when social eye gaze during object labeling matched their focus of attention. It appears to be easier for infants to learn words when they are attending to the object being labeled, rather than having to shift attention to a different object. Then, as infants become older, it may be easier for them to shift their attention in order to learn a label because they are more likely to understand the social aspect of the interaction. In the case of the present study, the younger infants may have had more difficulty transferring their attention from the speaker in the center of the screen to the object of reference. However, the older infants seemed to be able to shift their attention enough to attach the labels they heard to the objects indicated by the speaker.

The only other study, aside from the present one, that has used a controlled experimental procedure to examine social cues during word learning found that 15-month-olds were able to use social cues to learn labels for two objects (Houston-Price et al., 2006). As mentioned previously, they found that the infants looked at the target on average 52% of the time. However, while they did find that 15-month-old infants (which is a younger age than most social referencing studies) were able to learn under their conditions, the finding was relatively weak. The results in the present study with 18-month-olds, but not 14-month-olds, are consistent with Houston-Price et al.'s findings. Perhaps 15 months of age is around the time that social cues start to become beneficial for infants in the context of word learning. The 14-month-olds in the present study may be on the brink of using the social cues to their advantage, but aren't quite there yet. It could be useful to test 15-month-olds in this study to see if this is the age at which the ability to coordinate social cues with word learning develops, especially when two objects coincide with only one label.

Results from all of these studies may indicate that there could be two processes involved when learning labels for novel objects that coincide with one another. First, before infants can attach a label to an object, they must be able to discern which of the two objects is being labeled (i.e., attend to the social cues), and then be able to learn the actual word for that object. This may be a two-step process that develops over time; perhaps younger infants are able to pick out the intended referent with the help of the attention-directing aspect of social learning, but it is not until they are older that they can then attach a label to that referent for word learning.

Another theory that could explain the results of these studies is Stager and Werker's (1997) resource limitation explanation (as cited in Fennell & Werker, 2003). According to this notion, when infants are exposed to a difficult task, the resources available for attending to the task are limited. In Stager and Werker's series of studies, younger infants (8 months) were able to discriminate fine phonetic detail in tasks that required them to pair words with objects; however, older infants (14 months) were not able to do so. Because 8-month-olds are not yet in the word learning stage, they use their limited resources to attend to the phonetic detail of the words, rather than trying to attach the words to the objects (i.e., they treat the task as a sound discrimination task rather than a word learning task). However, because 14-month-olds are in the word learning stage, they are trying to assign meaning to the words they hear. Therefore, they are using their cognitive resources to attach meanings to words, but they are not able to attend to the phonetic details of the words at the same time (Stager & Werker). These results could relate to the current findings in that infants of 14 months are using what limited resources they have to try to attach meaning to the novel words, but they do not have enough cognitive resources left to use the social cues to help them in the process. Another hypothesis relating to this is that the younger infants are using their limited resources to attend to the social cues, and they do not have sufficient resources remaining to link the word to an object. If this is the case, then they would not be able to attach words to the objects because they are not processing the words. However, because 18-month-olds are more proficient word learners and may also be more proficient at processing social cues,

they are able to devote some of their attentional resources to listening to the words and assigning them meaning and some resources to attend to the social aspect of the task.

As indicated previously, additional analyses need to be conducted in order to understand precisely what 14-month-olds are interested in during these tasks. Are they captured by the salience of the speaker, which prevents them from benefiting from the social cues provided by the speaker? Is the word learning task simply too difficult for the infants to grasp, or are they too young to take advantage of the social cues after noticing them? Perhaps the social cues are overwhelming these infants to the point that they are not processing the labels that are presented to them? These questions will be explored in subsequent analyses and can hopefully be answered in future studies. One thing is for certain, though. Infants at both ages have achieved social understanding and understand the adult's referential intent in that they are aware of the social information provided within the scenes, and they can follow that information to a referent. However, only 18-month-olds are able to use that information in the service of actual word learning.

Table 1.

Descriptive Statistics for Test Trials for Experiments 1 and 2

Condition	Mean	Standard Deviation	N
Experiment 1-14 Months			
Consistent	.53	.12	12
Inconsistent	.54	.11	12
Experiment 2-18 Months			
Consistent	.56*	.08	12
Inconsistent	.46	.11	12

* $p = .03$

Table 2.

Descriptive Statistics for Training Trials for Experiments 1 and 2

Condition	Mean	Standard Deviation	N
Experiment 1-14 Months			
Consistent	.58**	.07	12
Inconsistent	.58**	.06	12
Overall	.58**	.07	24
Experiment 2-18 Months			
Consistent	.55*	.09	12
Inconsistent	.59**	.07	12
Overall	.57**	.08	24

*p = .06

**p < .003

Figure Captions

Figure 1. Examples of the training and test stimuli.

Training Stimuli

“Look Neem”

“Look Lif”

Test Stimulus

“Look Lif”

References

- Baldwin, D. A. (1991). Infants' contribution to the achievement of joint reference. *Child Development, 62*, 875-890.
- Baldwin, D. A., Markman, E., Bill, B., Desjardins, R. 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., & Moses, L.J. (1996). The ontogeny of social information gathering. *Child Development, 67*, 1915-1939.
- Baldwin, D. A., & Moses, L. J. (2001). Links between social understanding and early word learning: Challenges to current accounts. *Social Development, 10*, 309-329.
- Behne, T., Carpenter, M., & Tomasello, M. (2005). One-year-olds comprehend the communicative intentions behind gestures in a hiding game. *Developmental Science, 8*, 492-499.
- Blake, J., Vitale, G., Osborne, P., & Olshansky, E. (2005). A cross-cultural comparison of communicative gestures in human infants during the transition to language. *Gesture, 5*, 201-217.
- Bloom, L. (1973). *One word at a time: The use of single word utterances before syntax*. The Hague, The Netherlands: Mouton.
- Brooks, R., & Meltzoff, A.N. (2002). The importance of eyes: how infants interpret adult looking behavior. *Developmental Psychology, 38*, 958-966.
- Caron, A.J., Butler, S.C., & Brooks, R. (2002). Gaze following at 12 and 14 months: do the eyes matter? *British Journal of Developmental Psychology, 20*, 225-239.

- Cohen, L. B., Atkinson, D. J., & Chaput, H. H. (2000). Habit 2000: A new program for testing infant perception and cognition. (Version 1.0) [Computer software]. Austin: The University of Texas.
- DeLoache, J.S., Pierroustakos, S.L., Uttal, D.H., Rosengren, K.S., & Gottlieb, A. (1998). Grasping the nature of pictures. *Psychological Science*, 9, 205-210.
- Fennell, C. T., & Werker, J. F. (2003). Early word learners' ability to access phonetic detail in well-known words. *Language and Speech*, 46, 245-264.
- Goubet, N., Rochat, P., Maire-Leblond, C., & Poss, S. (2006). Learning from others in 9-18-month-old infants. *Infant and Child Development*, 15, 161-177.
- Hollich, G. J., Hirsh-Pasek, K., Golinkoff, R. M., Brand, R. J., Brown, E., Chung, H. L., et al. (2002). 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), v-123.
- Houston-Price, C., Plunkett, K., & Duffy, H. (2006). The use of social and salience cues in early word learning. *Journal of Experimental Child Psychology*, 95, 27-55.
- Koenig, M. A., & Echols, C. H. (2000). Infants' understanding of false labeling events: The referential roles of words and the speakers who use them. *Cognition*, 87, 179-208.
- Markman, E. M. (1990). Constraints children place on word meanings. *Cognitive Science*, 14, 154-173.
- Markman, E. M., & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meaning of words. *Cognitive Psychology*, 20, 121-157.

- Moll, H., & Tomasello, M. (2004). 12- and 18-month-old infants follow gaze to spaces behind barriers. *Developmental Science*, 7, F1-F9.
- Moore, C., Angelopoulos, M., & Bennet, P. (1999). Word learning in the context of referential and salience cues. *Developmental Psychology*, 35, 60-68.
- Moore, C., & Corkum, V. (1998). Infant gaze following based on eye direction. *British Journal of Developmental Review*, 14, 349-372.
- O'Neill, M., Bard, K. A., Linnell, M., & Fluck, M. (2005). Papers: Maternal gestures with 20-month-old infants in two contexts. *Developmental Science*, 8, 352-359.
- Quine, W. V. O. (1960). *Word and object*. Cambridge, MA: MIT Press.
- Shafer, G., & Plunkett, K. (1998). Rapid word learning by fifteen-month-olds under tightly controlled conditions. *Child Development*, 69 (2), 309-320.
- Sodian, B., & Thoermer, C. (2004). Infants' understanding of looking, pointing, and reaching as cues to goal-directed action. *Journal of Cognition and Development*, 5, 289-316.
- Stager, C. L., & Werker, J. F. (1997). Infants listen for more phonetic detail in speech perception than in word-learning tasks. *Nature*, 388, 381-382.
- von Hofsten, C., Dahlstrom, E., & Fredriksson, Y. (2005). 12-month-old infants' perception of attention direction in static video images. *Infancy*, 8, 217-231.
- Werker, J. F., Cohen, L. B., Lloyd, V. L., Casasola, M., & Stager, C. L. (1998). Acquisition of word-object associations by 14-month-old infants. *Developmental Psychology*, 34, 1289-1309.

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