

**Eye Gaze Does Not Attenuate Cognitive Load on 14-Month-Olds'
Word-Object Associative Learning for Minimal Pairs**

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ABSTRACT

It is well established in developmental science that 14-month-old infants have significant difficulty associating pairs of objects with pairs of words that differ by a single phoneme (i.e., minimal pairs). This study used a traditional switch procedure in two experimental conditions (i.e., no face versus face with shifting gaze) to habituate infants with objects and minimal pair labels. Additionally, infants’ participated in a joint attention task and parents completed questionnaires related to family demographics and infant health and development, to compare to switch task performance. It was expected that infants’ difficulty with minimal pair associative learning would be replicated in the no face condition. It was also predicted that the addition of a female face and the cues it could provide would abate the challenge that this task typically presents. As a group, infants’ performances in the two conditions were not significantly different from each other and were not significantly different from chance. Analyses explored the relations between switch performance, joint attention task performance and questionnaire data, resulting in a significant correlation between performance in the face condition of the switch task and number of ear infections ($r = .62, p < .05$). Taken together, the addition of a female face with shifting gaze to a challenging word learning task does not sufficiently attenuate the cognitive load created by the task. The implications of these results are discussed further.

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1. 0 - Introduction

In developmental science, a considerable amount of empirical focus has been placed on investigating the context of young children's referential word learning. That is, at what age and under what conditions do young children reliably learn the relationship between new words and the objects or actions to which they refer? In this quest, an experimental design known as the switch procedure has emerged, designed to investigate conditions affecting infants' ability to associate labels with objects. To date, a considerable number of published studies have capitalized on the switch paradigm in finding interesting and important influences on how infants learn to associate labels with objects. For example, infants are successful at learning labels for objects when the labels are highly contrasted in their linguistic features (Werker, Cohen, Lloyd, Casasola, & Stager, 1998) or when they have been exposed to the labels before entering the task (Fennell & Werker, 2003). Conversely, infants are not successful in the switch procedure when the object labels are minimal pairs (Stager & Werker, 1997). The primary goal of the current study was to examine whether the addition of an ostensive cue, eye gaze by a female face, would facilitate infants' attention in the switch task such that they would successfully learn object labels even when the labels consist of minimal pairs (e.g., "bin" vs. "din").

1.1 - Referential Learning in Infancy

Golinkoff, Mervis and Hirsh-Pasek (1994) have proposed a framework for understanding the phenomenon of infants' referential learning. Divided into two tiers, different principles help organize our understanding of the immense challenge that infants undertake as part of this task that is critical for their typical language development. Of particular interest to this study, the lower, basic tier of principles includes *reference* (the mapping of a label onto actions, objects and attributes), *extendibility* (similar phenomena can be referred to with similar labels), and *object* (at

this level of learning, labels map onto whole referents, not just their parts or attributes). To successfully learn the relationship between label and referent, infants must possess some degree of understanding that labels can be extended to targets of like kind, are applicable to the whole, and that these referential relationships are possible. Included in this idea of *reference* is the assumption that infants learn to segment the label for objects from surrounding speech, while using cues to identify the target of the label, and knowing that a teacher is making the reference intentionally (Golinkoff, et al., 1994).

In general, several studies have provided evidence for infants' segmentation of words from the speech stream (for reviews, see Christophe, Gout, Peperkamp, & Morgan, 2003; Jusczyk, 2007; Soderstrom, Conwell, Feldman, & Morgan, 2009). Infants are capable of using more than one lexical cue for segmentation, including pitch transitions, word familiarity, stress patterns, and/or conditional probability (e.g., Bortfeld, Morgan, Golinkoff, & Rathbun, 2005; Curtin, 2009; Fennell & Werker, 2003; Johnson & Jusczyk, 2001; Saffran, Aslin & Newport, 1996; Swingley & Aslin, 2002; Thiessen, Hill, & Saffran, 2005; Thiessen & Saffran, 2003). Thus, as infants transition into their second year, they possess the requisite skills for parsing and segmenting speech as they shift their focus onto referential learning.

Object-label learning. By 14 months of age there is clear evidence that infants can discriminate labels, objects, and actions, but the referential relationship between referent and label can be challenging. Studies on this topic have focused on what kind of conditions and object/label characteristics promote associative learning. For example, Werker, Cohen, Lloyd, Casasola and Stager (1998) conducted a series of experiments to learn about 14-month-old infants' ability to make associations between labels and objects as compared to infants of other ages, introducing the switch procedure. Adapted from a task using visual events (Younger &

Cohen, 1986), the switch is a derivation of a habituation protocol. Typically, infant participants are habituated to two different word-object pairings, ObjectA + LabelA, and ObjectB + LabelB. After meeting habituation criterion, infants are tested on two types of trials: a ‘familiar trial’ during which infants see and hear a familiar pairing (e.g., ObjectA + LabelA), and a ‘switch trial’ during which infants are presented with a mis-pairing between objects and words (e.g., ObjectA + LabelB). Looking times on switch trials are expected to be significantly longer than on familiar trials if infants are sensitive to the violation of the relationship between the learned words and their referents.

First in the series of experiments conducted by Werker and colleagues (1998), 14-month-old infants were habituated to two nonsense words, “neem” and “lif,” paired with two dynamic objects. “Neem” and “lif” differ in every phoneme, providing a high level of contrast. Infants who reached criterion during the habituation period (“habituated”) looked significantly longer on the switch test trials. Interestingly, of the habituated, only female infants looked at switch trials significantly longer whereas male habituated did not. In a subsequent experiment, the motion of the objects was equated (as opposed to earlier experiments in which the objects moved in different patterns), and the 14-month-old infants performed more uniformly as a group (i.e., recovered attention on switch trials). Importantly, this switch procedure does not tend to produce evidence of referential learning in younger infants (e.g., 8-, 10-, and 12-month-olds do not recover attention on the switch trials), even though younger infants easily discriminate the various labels themselves.

Taken together, these experiments demonstrate that 14-month-old infants, using a switch design, successfully complete word-object association tasks, but are affected by certain properties of the task itself. For example, the objects to be labeled need to be dynamic, as

opposed to static, to maintain the attention of the infant, while younger infants have difficulty with this kind of task, regardless of object movement. Additionally, Stager and Werker (1997) examined 14-month-olds' performance on word-object association tasks with labels that differed only by one element in their acoustic properties (i.e. minimal pairs). Infants were habituated to ObjectA + "bih" and ObjectB + "dih", followed by testing on familiar and switch trials (e.g., ObjectA + "dih"). Infants showed no significant difference in looking times on switch trials. This results stands in contrast to the study by Werker et al. (1998) discussed above using the labels "neem" and "lif."

Questioning why the use of minimal pairs proved too difficult for 14-month-olds, the procedure was repeated using only one label and object during habituation, and then presenting that same object but with a new, minimal object label during test. Again, 14-month-olds did not recover attention on test trials even though the object label was novel. In contrast, 8-month-olds in the same protocol did significantly increase attention on the test trials, suggesting that the failure of the 14-month-olds was not due to perceptual difficulty. Rather, Stager and Werker proposed that the 8-month-olds processed this as a discrimination task, whereas the older infants processed this as a referential task, and failed to fully encode the label as they formed its association with the object, such that "bih" and "dih" were confusable. In support of this interpretation, a final experiment with 14-month-olds being tested with a novel label that was differed in every phoneme from the one during habituation significant recovery of attention on the switch trials.

Following up on the finding of 8-month-olds successfully distinguishing between minimal pairs, while 14-month-olds did not, Werker, Fennell, Corcoran and Stager (2002) isolated and addressed other documented developmental inconsistencies in infant performance.

Some studies, for example, found that children's difficulties with similar sounding words continue into the preschool years, whereas other studies have found that by the age of 18 months, infants are sensitive to and use fine phonetic detail when engaged in object-label associative tasks, raising speculation that these contradictions can be attributed to developmental differences of some sort or task difficulty. To address these issues, Werker and colleagues (2002) conducted a series of switch experiments with minimal pair labels and ultimately concluded that switch performance improves with age, with infants consistently succeeding by 20-months of age.

In all of the previous studies, the words used as labels were unfamiliar, nonsense words. It may have been possible that infants' lack of experience with the labels increased the difficulty of the task. In light of this, Swingley and Aslin (2002) conducted an experiment with 15-month-old infants in word-object association tasks with a visual fixation task, with familiar words and mispronunciations (e.g. baby and vaby) instead of novel, nonsense pairs. The mispronounced labels were either close to or distant to the correct pronunciation, both resulting in words that are very similar to the original. When tested, the infants preferred and more easily recognized correctly pronounced labels to the mispronounced, so under these conditions, familiarity with at least one of the labels superseded the minimal contrast between the labels (Swingley & Aslin, 2002).

In the previously discussed study, the change in label familiarity appeared to make the association between label and referent easier, but the use of the visual fixation task may have also eased the complexity associated with this challenge, so to build on Swingley and Aslin's findings (2002), Fennell and Werker (2003) used the switch protocol with 14-month-old infants, using familiar minimal pair (e.g., "doll" and "ball") labels and their real-world corresponding

objects. Under these circumstances, the infants did significantly increase attention on switch trials.

Overall, it is becoming increasingly clear that very similar word pairs present infants with a difficult challenge as they begin recognizing the associations between referents' and their labels, and as demonstrated by Fennell and Werker (2003), the difficulties presented by minimal pairs can be mediated by more salient characteristics and circumstances. For example, Pater, Stager and Werker (2004) used a switch protocol to test infants' ability to distinguish pairs of words with limited contrast. After various manipulations, they concluded that words pairs that differ between place and manner of articulation, voicing, and both articulation and voicing all contribute to infant difficulty and prevent their success on the switch task (Pater, Stager, & Werker, 2004). Similarly, Curtin (2009) tested 12-month-old infants with two 3-syllable words that differed by stress pattern only (BEdoka/beDOka). In this experiment, 75% of the infants significantly recovered attention on the switch trials. This high level of performance, during an age range when infants are typically unsuccessful in this protocol, was attributed to the salience of stress in English and its importance in identifying word classes and the segmentation of words (Curtin, 2009).

Extending this finding to other protocols, Yoshida, Fennell, Swingley and Werker (2009) tested 14-month-old infants in a visual choice task, using "bin" and "din" as labels. After familiarizing the infants with ObjectA + "bin" and ObjectB + "din" (for example), infants were exposed to test trials, during which both objects were visible to the infant, but only one word was played via a soundtrack. The mean look time to the target object was significantly greater than chance. The switch task and the visual choice task both require that the infant identify the object that is associated with the label that they hear. In the testing phase of the visual choice, however,

the infant may have less difficulty choosing the target object because they are both visible, increasing confidence in their word representations. Therefore, failure on switch tasks may be due to the difficulty presented in the testing phase.

Interpretations of referential learning task performance. The performances of infants on referential learning tasks can be interpreted as the product of individual differences and cognitive resources. For example, performance can be attributed to developmental differences between infants, especially differences in linguistic exposure, cognitive development, and infants' ability to distribute their attention across events. When infants demonstrate difficulty recognizing and associating labels and their referents, it is due to the infant being pushed to the limits of their cognitive resources for the task. Limitations on cognitive resources could be solely related to development or could be related to task complexity and difficulty (Fennell & Werker, 2003; Pater, et al., 2004; Werker, et al., 2002). Infants' ability to sufficiently attend to labels and their referents could also be a consequence of reaching cognitive resource limits (Fennell & Werker, 2003).

Potentially included in this interpretation is a focus more specifically on infants' linguistic exposure and ability to form representations. This supposes that an infant's performance on referential learning tasks is related to their cognitive ability to create sufficient mental representations of the words they are learning and the amount of attention required to do so. The representations for similar sounding words form neighborhoods, and if a new word sounds like an existing representation, less attention is required to form the new representation (and ensuing errors may occur in recognition due to faulty encoding). Similarly, if a new word is unlike previously acquired words, more attention will be required to form a representation sufficient for later recognition (Swingley & Aslin, 2002). Additionally, when labels differ by a

single acoustic property, failures to successfully attach them to objects may be due to an inability to differentiate between the labels' representations because they were not sufficiently formed, or because they are too similar to distinguish (Yoshida, et al., 2004).

Important to the current study, this overall perspective mentions but does not emphasize the need for infants to extend sufficient attention to the task for successful performance. Infants must be able to create clear and complete lexical representations, requiring sufficient attention to the label and referent for creation of the representation. In addition, the previous studies have demonstrated that features of the audiovisual presentations and how they elicit infant attention are specifically related to their performances. For example, Werker et al. (1998) manipulated and controlled for movement after finding that without the use of dynamic objects, infants did not appear able to associate objects and labels. The use of moving visual events was necessary to sustain the attention of the infant during the task to make referential learning possible (see Courage, Reynolds, & Richards, 2006). Pater, Stager, and Werker (2004) and Curtin (2009) provide evidence that some characteristics (e.g., syllabic stress) of the auditory events used during various protocols were more salient than others, and therefore, elicited more attention than less salient characteristics (e.g., place of articulation). Thus, examining how aspects of referential contexts help regulate infants' attention, promoting better word-object learning, advances this literature. One such potential context is a social one, during which infants' attention is guided by the presence of adults.

1.2 - Ostensive Cues and Attention in Infancy

It is well established that typically developing infants have an early and strong preference for and pay great amounts of attention to faces (e.g., Blass & Camp, 2003; Courage, et al., 2006; Valenza, Simion, Cassia, & Umiltà, 1996). Also, at the same time infants are acquiring language,

they are also becoming increasingly engaged in social interactions. While infants have been participating in social interactions since (at least) birth, the level of engagement is deepened because they are beginning to recognize their own social agency. That is, they are able to interact with others with increasing awareness that they can influence the attention of others and receive cues from social partners to direct their own attention. As such, social and joint attention skills are positively correlated with language skill (Baldwin, 1995; Morales, et al., 2000; Tomasello & Farrar, 1996). This makes sense because language is ultimately a social activity that is dependent upon interactions with others. Given this highly social nature of infants, the addition of events that are ostensive in nature to experiments utilizing the switch procedure could improve infants' performance because the heightened level of arousal and attention that is elicited by the social nature of the event extends to other events present.

Courage, et al. (2006) demonstrated the power of the social visual events on infant attention. Measuring heart rate and look duration during a habituation protocol, varying patterns preferences were identified based on the attention infants paid to each kind of event. The events consisted of static pictures and dynamic movie versions of 4 visual events: a woman's face, white dots on a black background, white triangles and bars on a black background, and Sesame Street clips. First, infants always preferred dynamic movies to static images of the objects or scenes. Second, look times decreased significantly for infants in the 26-week-old group as compared to the 14-week-old group. The look times for infants older than this differed depending on the social nature of the events. Look times for the geometric, nonsocial events continued to decrease, while the look times for the social stimuli increased. This increase in attention was more pronounced for the Sesame Street clips than for the movies of the woman's

face. This study clearly demonstrates that events that are social in nature are better at eliciting and sustaining infants' attention than those that are nonsocial in nature.

In addition to being attracted to social events, as they gain more experience, infants also come to understand that attending to various cues from a social partner can provide them with information about their environment. Gaze following is an early and crucial ostensive cue that serves as a mechanism for making connections between objects and labels. While gaze following may be reflexive at first, infants eventually learn how to follow gaze volitionally to aid in interactions with a social partner.

In two studies conducted by Tomasello and Farrar (1986), infants, between the ages of 12- and 18-months-old, and mothers talked more when engaged in an episode of joint attention, and the types of references made by mothers during joint attention episodes and following infant's attention are both positively correlated with measures of infant language learning taken at 21-months-old. Also, in interactions with unfamiliar experimenters, 14- to 23-month-old infants better learned references for objects when the labels are provided immediately following infant's attention to the target object, as opposed to the label being provided when the infant is not attending to the referent.

Morales, Mundy, and Rojas (1998) found that infants are able to reliably follow the gaze of their caregivers if the target of the gaze is within the infants' visual field. In addition, the ability to follow gaze is significantly positively correlated with receptive vocabulary at 12-months of age and expressive vocabulary at 18-months of age.

A series of studies conducted on infant gaze by Senju, Csibra and Johnson (2008) concluded that infants were more attentive to faces that looked in the direction of objects than they were to faces that looked in the opposite direction of an object. They also concluded that

infants of at least 9-months of age come to expect eye gaze to imply reference because they do not respond to closed eyes “gazing” at an object the way they do when the eyes are open and actually gazing.

While gaze is clearly important for infants’ attention to social interactions and accessing the information provided in those interactions, it is not the only factor that influences this process. As demonstrated by Panneton and Richards (2011), the bimodal presentation of voice and face elicits more prolonged attention than unimodal presentations of face or voice only. This sustained attention to face and voice is likely to also promote the processing of information conveyed by the audiovisual event. The sustained attention elicited by audiovisual presentations of face and voice and the information processing it enhances may be especially true for social interactions that convey information about speech and language, like object-label pairings.

1.3 - Pilot Data in Support of the Current Study

Pilot data collected by the Infant Perception Lab at Virginia Tech provides additional evidence that increasing attention to a switch task through social means improves performance. Infants, aged 13- to 15-months old, participated in two conditions of a standard word-object switch protocol with nonsense labels. In the social condition, the infants were oriented to the audiovisual events on a screen by a woman’s face, whose eyes shifted in the direction of an object when it appeared. In the nonsocial condition, the orienting event was the same face but scrambled in such a way as to minimize its identification as a face (but preserving visual spatial frequency and contrast functions). Orders of receiving the social or non-social versions of the task were counterbalanced across infants. Novel ratios were calculated for each condition (i.e. the look time on switch trials divided by the total look time across all test trials) and compared. The infants looked significantly longer, $F(1,10) = 6.762, p = .026$ on switch trials, with their

ratio of attention on switch trials to familiar trials significantly above chance ($M = .59$) in the social condition but not in the nonsocial condition ($M = .50$).

Based on these pilot data, the purpose of this current study was to investigate whether the addition of a woman's face with initial gaze toward the infant and then eye gaze on the object being labeled would improve infants' discrimination of minimal pair words. First, it was hypothesized that the findings of previous studies (e.g., Stager & Werker, 1997) would be replicated in the nonsocial (i.e., no face) switch condition. That is, infants would not recognize the switching of minimal pair labels during testing when habituated to object-word pairings with no face present. Second, it was hypothesized that infants would pay significantly more attention to the objects and labels during habituation as a result of the presence of the face and the orienting gaze cues the face can provide, resulting in significant recovery of attention (i.e., greater looking times) on switch trials, even when exposed to minimal pair object labels (Figure 1). Exploratory analyses were also conducted to explore the relationships between switch task performance, joint attention task performance, and vocabulary.

2.0 - Methods

2.1 - Participants

The participants in this study were twelve 13- to 19-month-old infants (4 Male; $M=14.69$, $SD = 1.97$, 13.3-19.7). The sample of infants used in this study represents the average population around Blacksburg, VA. Infants were recruited from the database maintained by the faculty associated with the Developmental Research Suite in the Department of Psychology. This database maintains parent contact information and is derived from purchased mailing lists (InfoUSA), recommendations by other participating parents, and also referrals from other research labs in the department. Additionally, participants were recruited through postings on email listservs for graduate students at Virginia Tech, flyers on public bulletin boards in the Blacksburg area, and advertisements placed in *The Burgs*, a local newspaper. If recruited through the database, parents were sent a letter inviting them to participate in studies. Shortly after the receipt of those letters, Infant Perception Lab members made follow-up phone calls. Data from 11 additional infants was incomplete and excluded due to excessive fussiness or disinterest (7), failure to habituation (1), and experimental error (3).

2.2 - Measures and Materials

Questionnaires. Caregivers completed a series of questionnaires that included a demographic questionnaire (Appendix A), a temperament questionnaire (Appendix B) and, the Language Development Survey (LDS) sub-section of the preschool Child Behavior Checklist (CBC/1½ - 5) to assess expressive language (Appendix C). In addition to providing information to describe the sample of this study, these measures also provided details about attributes of the infants and their communicative development that may be related to how they associate labels and objects as indicated by their performance on the switch tasks.

Equipment and experimental events. Infants experienced multimodal events on a 32” NEC brand LCD monitor, approximately 70 cm away from them, with speakers on either side hidden by a black curtain. The sounds the infant heard during the procedure will be standardized to 65-70 dB SPL (A scale), as measured from the general head area of the infant. A remote-controlled Panasonic camera (WV-cs574) was positioned approximately 5” above the monitor and was controlled in an adjacent room by an observer. Each session was viewed live on a GE television/VCR, and recorded by a Sony DVD recorder. The purpose of this camera system was twofold: (1) to allow the observer to keep the infant in the center of the observation screen in the adjacent room as the observer is continuously monitored the infant’s gaze to the central screen, and (2) to provide visual input to the DVD recorder to digitally store each session for later reliability coding (offline). The audiovisual events were controlled on an iMac, using Habit X 1.0. The primary observer entered whether or not the infant was looking at the screen into Habit to measure the infant’s looking time for each trial. The observer controlling Habit could not see or hear what the infant was experiencing to reduce bias during live coding. Similarly, most caregivers wore Bose QC15 noise-cancelling headphones through which soft, vocal music was played. The purpose of the headphones was to keep the parent unaware of the specific sounds that the infant was hearing so that the parents’ reactions would not influence the infants’ reactions to the critical change in object-word pairings (discussed in more detail below). Some parents opted to not wear the headphones out of concern that they would distract their infant.

Visual Events. The objects shown to the infants were selected because they were items that were not likely to be known to the infants, helping to ensure they had not previously learned labels for them. The objects included photos of a four geometric, three-dimensional figures of varying shapes, orientations and colors (Appendix D). Adobe Premiere © was used to

standardize the size of the objects and to create video clips by combining still images of the objects in different positions and at different locations on the screen to create a two standardized, animated effects, horizontal tilting or vertical hopping. The movement of the objects was the same within condition, so each infant experienced both kinds of movement. The order of the movement was counterbalanced with condition across the infants.

Audio Events. Two different minimal pairs were used as word labels in each condition. The minimal pairs used in this study were of the form consonant-vowel-consonant (CVC), single syllable words that only differed by first consonant. In one condition the minimal pair consisted of “bin” (as in “cabin”) and “din” (as in “dinner”). In the other condition, the minimal pair consisted of “pem” (as in “Pembroke”) and “gem” (as in “gemote”). In both minimal pairs, the vowels were short, center vowels. The ending consonants of both pairs were nasal glides. All of the beginnings phonemes were labial (/b/ and /p/), dental (/d/) or velar (/g/) stop consonants. Adobe Premiere © was used to dub these spoken labels to the video clips and to ensure the labels were not synchronous with the movement of the objects.

Joint attention task materials. A card table was set up with the experimenter’s chair on one-side of a small table and the parent’s chair and a high chair on the opposite side, closest to the wall. Four posters were on three adjacent walls; two posters were on either side of the infant’s position and the other two were located behind the right and left side of the infant. Several windup toys and a ball used during the joint attention protocol were in a basket next to the experimenter. A second basket was also provided for collecting the used toys to be cleaned after the session. A video camera and tripod were positioned behind the experimenter, facing the infant, to record the sessions. A small whiteboard displaying the experiment and subject number

was mounted on the wall between the two posters behind the infant, so the sessions could be identified for scoring offline.

2.3 - Procedures

A portion of the questionnaires were completed by the accompanying parent prior to testing, in addition to informed consent materials (Appendices E and F). However, the LDS was completed while the infant and experimenter were engaged in the Joint Attention Task and after all of the tasks were completed, as needed. Each parent was provided with a copy of the consent form they completed as well as a certificate of contribution for the infant as a keepsake.

Habituation protocol. For both conditions' habituation protocols, the infant was seated on their caregiver's lap in a sound-attenuated room to watch and listen to audiovisual events. Each infant participated in two conditions of a switch protocol. Each condition consisted of a series of habituation trials to expose them to word-object pairings. In one condition, the infants were attracted to the screen by a cycling video of a laughing and smiling infant (attention getter). When the infant was focused on the attention getter (as determined by the observer), the first habituation trial began. An object appeared on one side of the screen 2 s after trial initiation, and moved in a horizontal or vertical fashion as previously described. While the object was visible, the infant heard two different tokens of a unique label (e.g. /bin/) for the object spoken in typical infant-directed style by a female adult. Each token was available two times in every complete 10 second cycle. The maximum trial duration was 20 s, however, all trials were infant-controlled so that looking away from the screen for more than 1 s terminated that presentation.

Upon termination of any trial, the attention getter came on again to reorient the infant's attention to the screen, and the next trial began when the infant was focused on the centering event for at least 3 s. On the next trial, a different object appeared on the same side of the screen.

Again, the adult female voice repeated different tokens of a second unique label (e.g. /din/) for the object in infant-directed style while the object was being displayed. The movements of the objects and the onset of the labels were not synchronized (i.e., the labels were only heard when the object was still). These two types of habituation trials (i.e., ObjectA + LabelA and ObjectB + LabelB) continued across alternating trials until the infant reached the maximum number of habituation trials (20, 10 of each object-word pairing) or criterion was reached, whichever came first. Criterion was reached when the infant's mean looking time for two sets of consecutive trials pairs were both less than 50% of the mean of the first two trials. At this point, the infant was considered habituated to the multimodal events they experienced.

Testing. During testing, there were two trials with events identical to those provided during habituation and two trials during which the labels for the objects were switched (e.g., the gold sculpture labeled with /bin/ in habituation was labeled with /din/ during testing). The order of testing trials was the same for all infants with switch trials, hereafter called novel trials (N), first and fourth and familiar (F) trials second and third (NFFN). As during the habituation trials, each trial continued as long as the infant was looking at the screen or until the maximum trial length of 20 s has been reached. If a trial ended because the infant looked away before the end of the trial, the attention getter came on to refocus the infant to the monitor before the next trial began.

Experimental conditions. The habituation procedure was the same for both experimental conditions, but the specific multimodal events differed. To start, two pairs of objects and labels were used during habituation (e.g. object 1 labeled with /bin/ and object 2 labeled with /din/ in one condition, and object 3 and object 4 labeled with /pem/ and /gem/ respectively in the other condition). The objects and labels were counterbalanced across conditions, and each infant

experienced both pairs across their conditions. Moreover, which condition the infant experienced first (face or no face) was counterbalanced.

Most importantly, the conditions differed by whether or not a female face was provided on the side of the screen opposite the object presentation side. During the face condition (Face), a woman, visible from her shoulders up to the top of her head, appeared on one side of the screen with eyes looking forward. After two seconds, her eyes shifted toward the same side of the screen on which the object appeared (Appendices G and H). The eyes remained shifted toward the object as long as it remained on the screen. In the second condition, a woman did not appear on the screen, and the “face side” of the screen was blank (No Face), with the objects still appearing two seconds after trial initiation. The side of the screen that the objects appeared on was consistent for both conditions for each infant but was counterbalanced across infants.

Joint attention. After completing the first switch condition, the infants participated in an interactive play activity with a trained research assistant. The tri-fold partition was folded and placed out of the way during this protocol. A camera was placed behind the right shoulder of the experimenter, so that the infant and the whiteboard were in view. The full toy basket was placed on the floor on one side of the experimenter, along with an empty basket to receive used toys. Joint attention sessions consisted of 7 trials. During the first (P1), fourth (P2), and seventh (P3) trials the experimenter looked to and pointed to each poster on the wall one time each. The direction in which the experimenter pointed to the posters was consistent within a trial (i.e., left to right), but alternated across trials. On trials 2 (T1), 3 (T2), 5 (T3), and 6 (T4), the experimenter activated a wind-up toy to move across the table two times (e.g. right to left then left to right), alternating the direction of the movements from trial to trial. While the toy was on the table, the experimenter shifted their gaze naturally from the toy to the infant while making a statement

about it (e.g., “That silly monkey is walking.”). At the discretion of the experimenter, if the infant got disinterested, fussy, etc., the trials were interrupted to play with a ball in hopes of regaining the infant’s interest. The task was also ended early in the event the child did not regain interest. At the end of the appointment, all of the toys the infant came into contact with were disinfected to prepare them for use with other infants and returned to the original toy basket.

3.0 - Results

3.1 - Switch Performance

To begin, 11 of the 12 infants viewed the Face condition first, followed by the No Face condition, so analyses were not conducted to determine the role of presentation order on performance. This is a limitation of this study that will be discussed in more detail later. To determine at the group level whether or not the infants performed differently in the Face and No Face conditions, a repeated measures ANOVA compared each infant's looking times as a function of trial type (2: novel, familiar) and condition (2: face, no face). This comparison yielded no significant main effect of condition ($F(1, 11) = 1.571, p = .213, \eta^2 = .14$), main effect of trial type ($F(1, 11) = 4.171, p = .422, \eta^2 = .06$), nor the trial type x condition interaction ($F(1, 11) = .055, p = .819, \eta^2 = .01$; Figure 2). This comparison was also conducted using the first novel and first familiar test trials from both conditions for each infant. Again, neither condition (2: face, no face) ($F(1, 11) = 3.903, p = .074, \eta^2 = .262$), trial type (2: novel, familiar) ($F(1, 11) = 2.368, p = .152, \eta^2 = .152$), nor the condition x trial type interaction ($F(1, 11) = .045, p = .835, \eta^2 = .004$) were significant (Figure 3). Additionally, the number of habituation trials required by infants' to reach habituation was not significantly different between conditions ($t(19) = .67, p = .51$), and the average look looking time during the first two habituation trials also did not differ by condition ($t(19) = .08, p = .94$).

Although an analysis of average look durations on novel and familiar trials during test did not show evidence of infants' associative learning of the words and objects, another way to approach these data is to construct novelty ratios by calculating the proportion of looking on novel to familiar trials, regardless of absolute differences in durations across infants. These ratios (Novel/(Novel+Familiar)) can then be tested against .50 (chance performance; Figure 4).

At the group level, neither the novelty ratios from the No Face Condition ($t(11) = 1.04, p = .32$) nor the novelty ratios in the Face condition ($t(11) = .37, p = .72$) differed significantly from 0.5. In addition, the comparison of mean novelty ratios between conditions did not yield a significant result ($t(11) = .33, p = .75$).

Although the group-level analyses indicate that infants' performance did not differ from chance, looking at the pairs of novelty ratios for each infant illustrate a more complex pattern of results (Figure 5). If the infants are split into sub-groups based on whether their novelty ratio in the Face condition is $> .5$ or $\leq .5$, novelty ratios in the No Face condition are not significantly different between the sub-groups ($t(10) = .614, p = .553$), while those from the No Face condition, however, do differ significantly ($t(10) = 7.26, p < .001$). This difference was examined more closely by comparing the Face condition novelty ratios from both sub-groups to .5. Both of these group-level ratios were significantly different from .5 ($>.5$ sub-group: $M = .64, SD = .07$), $t(4) = 4.83, p = .008$; $\leq .5$ sub-group: $M = .42, SD = .04, t(6) = 5.18, p = .002$).

Looking patterns. To more fully understand the lack of evidence for discrimination on the switch trials in the face condition, analyses were conducted to explore the looking durations and looking frequency to the different visual targets displayed during habituation (i.e, the face and the objects in the face condition, and just the objects in the no face condition; Figure 6). A repeated measures ANOVA compared each infant's total looking time during habituation as a function of target (2: Face/Blank, Object) and condition (2:Face, No Face). With regard to duration, and as expected when comparing conditions, infants looked significantly longer to the face in the Face condition than to the blank area of the screen in the No Face condition ($t(12) = 7.542, p < .001$). In contrast, infants did not look significantly longer at the objects in one condition versus the other ($t(12) = 1.888, p = .083$). Within the Face condition, infants looked

significantly longer to the face than to the objects ($t(12)= 2.177, p= .05$). In contrast, infants looked significantly longer to the objects than to the blank side in the no face condition ($t(12)= 4.324, p= .001$).

The same comparisons were made for look frequency (i.e., the number of independent fixations on a target; Figure 7). As in the previous analyses of look durations, infants looked significantly more often to face in the Face condition than to the blank side in the No Face condition ($t(12)= 4.76, p< .001$) and to the objects in the Face condition than the No Face condition ($t(12)= 3.82, p= .002$). Infants looked equally often to the face and the objects in the Face condition ($t(12)= 1.68, p= .12$), but more often to the objects than the blank side in the No Face condition ($t(12)= 3.78, p= .003$).

As with the novelty ratios, the looking patterns of infants were examined based on their Face novelty ratio sub- groups (i.e., Face condition novelty ratio $> .5$ or $\leq .5$). There were no significant differences between the sub-groups in terms of look frequencies and durations to the different targets, but there are differences within the groups. For infants with Face novelty ratios > 0.5 , there were no significant differences in look durations or counts to face or object between conditions. Moreover, there were no significant differences in look duration or count to face versus object within either condition (Table 1).

In contrast, for infants whose novelty ratio from the Face condition is less than or equal to 0.5, as would be expected in the No Face condition, infants looks significantly more frequently ($t(6)= 3.09, p= .02$) and significantly longer ($t(6)= 2.87, p= .03$) to the object than the blank side of the screen. In the face condition, the opposite pattern occurs. The infants in this sub-group looked significantly more frequently to the face than to the object ($t(6)= 6.74, p= .001$), but not longer to face than to the object ($t(6)= 2.16, p= .075$; Table 2).

3.2 - Joint Attention

Another pattern of interest in this study was the relationship between infants' attention on novel and familiar trials during the two switch tasks and their tendency to engage in joint attention with a trained research assistant. Two measures were calculated from the joint attention sessions: Response to Joint Attention (RJA; percentage of trials when the infant looked to the poster to which the assistant pointed) and Eye Contact (EC; number of times infant made eye contact with the assistant during the toy trials). Although a predictive relation between RJA and expressive vocabulary (i.e., number of words spontaneously produced by the infant), such a relation not significant in the current study ($R^2 = .32$, $F(1,10) = 4.70$, $p = .055$, $\beta = .57$). In addition, the joint attention measures, questionnaire responses and novelty ratios from both conditions were correlated (Table 3). Interestingly, Pearson correlations between RJA and EC did not indicate a significant relation ($r = .18$, $p = .51$). However, RJA was significantly correlated with infants' novelty ratios from the no face condition ($r = .59$, $p = .03$), but not with the novelty ratios from the face condition ($r = .21$, $p = .52$).

3.3 - Questionnaire Results

Correlations were calculated for item responses from the three questionnaires (i.e, family demographics, temperament and LDS) and novelty ratios (Table 4). Interestingly, ear infections were significantly positively correlated with the novelty ratios from the face condition ($r = .62$, $p < .05$). No other correlations of specific interest to this study were significant.

4.0 - Discussion

It was the goal of this study to explore conditions that would augment infants' success in mapping novel verbal labels that differed by a single phoneme (i.e., minimal pairs) onto novel visual objects. Specifically, I was interested in whether the presence of a female face who gazed at the object being named, accompanied by a female voice naming the object in an infant-directed style were the kinds of ostensive cues that augment infants' attention. However, the results did not provide significant evidence for the benefit from the presence of a woman's face or the cues she provided in infants' ability to learn difficult verbal labels for objects.

As mentioned in the introduction, a pilot study comparing infants' switch performance using maximal pairs (e.g., "boog" vs. "neem") found that the presence of the female face with her eye gaze toward the object resulted in significantly longer look durations during the novel trials and novelty ratios significantly above .50. Figure 8 depicts the pattern of novelty ratios from the pilot study to those from the Face condition in the current study. Word pairs with a high degree of contrast, like those used in the pilot study, have been demonstrated to be relatively easy for infants to associate with objects, compared to the task of associating minimal pairs (e.g., Fennell & Werker, 2003). In the current study, although the difference was not significant, the average total looking time to the face ($M = 60.77$, $SD = 25.70$) was longer than the average total looking time to the objects ($M = 46.00$, $SD = 29.47$) in the Face condition. Because both studies used the same face as part of the audiovisual presentation, analyses were conducted to see if infants' allocated their attention differently to the face between these two studies. The look counts and durations from the Face condition in this study were compared to those from the Social condition in the pilot study. Infants' in both experiments looked equally long ($t(18) = .089$, $p = .93$) and equally as often ($t(19) = 1.35$, $p = .19$) to the face.

Previous work in which a face was introduced in a word learning task, gave some indication that, as an ostensive cue, faces might help infants make associations between objects and labels (Fais et al, 2012). Even newborn infants have been shown to follow the gaze of an actor toward an object but only after mutual gaze between the infant and actor was first established or when an opening phrase signaling communicative intent toward the infant was presented in typical infant-directed style (e.g., “Hi baby”; Senju & Csibra, 2008). While the shifting gaze provided by a face might cue the direction in which an event is going to occur, the findings from the current study suggest that this information alone does not indicate to the infant that the information that is going to be provided is ostensibly meant for them. That is, in the experiment presented here, the shift of the eyes from the infant to the object at the beginning of each trial appeared insufficient to elicit and maintain the type of focused attention needed to perform well with the minimal pairs. In fact, the looking pattern data provide evidence that infants looked back and forth more often between face and object when the face was present, dividing their attention among the visual presentations, particularly to the face. Without the ability to re-engage with the woman’s eyes when infants looked at the face, infants’ attention was not redirected to the object. Thus, poor associative learning may have stemmed in part from the use of a static, rather than dynamic presentation.

In a pair of studies by Fais, et al. (2012), 14-month-old infants participated in a similarly designed protocol, but importantly, in the switch task, a live experimenter provided the minimal pair labels provided for the objects. In the first of these experiments, a woman was seated between the infant and the screen on which the objects would appear. The woman engaged in natural gaze shifting between the infant and the object on the screen, allowing the infants to share mutual and contingent gaze with her frequently through out the task. Although the labels

for the objects were given by a dynamic, in-person source, even the infants in Fais et al. (2012) were not successful in learning the minimal pair labels *as a group*. However, individual infants were successful if they engaged in more mutual gaze with the live actor throughout the task. In the second experiment, this design was repeated with a video of a woman instead of a live person, removing any contingency in gaze that may have occurred in the prior design and infants were not successful (Fais et al., 2012).

In comparing these experiments by Fais and colleagues, the ability to engage and re-engage eye contact with a social partner was able to alleviate some of the cognitive load that minimal pairs present in a word learning context. Although an analysis of mutual gaze is not possible with the current study, comparisons were made between infants' expressive vocabularies and their looking durations and frequencies in both conditions and to both targets to see if there was any relationship. Despite the relationship between word learning and mutual gaze found by Fais and colleagues, there were no significant correlations between expressive vocabulary and any of the looking pattern measures.

This impact of ostensive cuing on infant information processing may be due in part to the ability of dynamic mutual gaze and smiling to elicit activity in areas of cortex that are typically associated with selective attention (e.g., anterior N200 in prefrontal cortex; Grossman et al., 2008; Senju, Johnson, & Csibra, 2006). This is particularly interesting because gaze contingency was not as likely in the current study or previous studies where 14-month-olds' difficulty with minimal pair object labels were illustrated. That is, although the female face presented in the current study did begin with eyes forward, offering an opportunity for mutual gaze, no specific contingency was present. That is, her gaze remained shifted throughout the duration of the trial, independent of infant gaze.

In a recent paper by Kidd, Piantadosi, and Aslin (2012), infants' reactions to different kinds of audiovisual presentations were found to be a function of the amount of information in the presentations. Based on their results, infants were more likely to look away from the screen when the audiovisual presentations provided too much or too little information. Labeled the 'Goldilocks Effect,' the amount of information available to infants must be moderately complex to elicit and maintain their attention. Considering this effect in terms of the present study, there is specific information intended for the infant in both the audio and visual components of the videos. It is possible that, regardless of whether or not a face was present to inform the infant of future events, without contingent information, these presentations did not provide enough motivation for infants to successfully represent a relationship between minimal pair labels and objects.

Moreover, there were several issues in the design and execution of this study that should be discussed as limitations. A primary limitation of this study is that the order of presentation for almost all infants was the Face condition preceding No Face condition. Because of selective attrition, the data from several infants who received the No Face condition first are not included in our results. The inability to compare the order of presentation prevents analyses that might provide evidence as to how infants' might have been helped by the face. For example, we cannot examine if the cues provided by the face or the attention it attracts improve performance in the No Face condition, compared to infants who did not see the face first.

Future studies might explore the positive predictive relationship between ear infections and Face condition performance. The assessment of ear infections used in this study was categorical and therefore not very specific. It is likely that what parents reported was the number of doctors visits that have occurred related to ear infections. It's possible, however, that for

children for whom ear infections appear chronic may actually be the result of constant low-grade tympanic membrane inflammation with especially enflamed periods. The best way to address this in the future would be to conduct tympanograms as part of the measures taken during a lab visit to assess the rigidity of the tympanic membrane and quantify how it is conducting sound.

In addition to infant characteristics, characteristics of the presentations are critical. Comparing this study and the study by Fais et al. (2012) helps to illustrate that dynamic and contingent presentations of faces enhance infants' processing of even complicated associated events. Another key feature from the study by Fais et al. (2012) that should be questioned and considered for further explorations of this phenomenon is the use of a live experimenter. Kuhl, Tsao and Liu (2003) provide evidence not only for the importance of a live social partner, over learning from viewing a screen only. American infants were exposed to Mandarin Chinese over the course of several weeks in a live or pre-recorded condition. When tested for their ability to detect phonetic contrasts that exist in Mandarin but not in English, infants in the live experimenter condition were successful, whereas those in the recorded condition were not. Taken together, these studies demonstrate how live experimenters can more easily provide the contingent interactions that appear to be especially critical for infant learning. That being said, the use of live experimenters does provide opportunity for inconsistencies in the presentations to infants, and so should be considered thoughtfully.

Future studies would benefit from the use of eye-tracking technology in several ways. An eye tracker would allow for the presentation to change (i.e., gaze shift and object presentation) to be specifically contingent on the infant sharing mutual gaze with the face as was demonstrated to be crucial by Fais et al. (2012). Senju and Csibra (2008) also showed that infants' following of a social partner's gaze is dependent on the presence of ostensive cues (i.e., mutual gaze, infant-

directed speech) before the shifting of gaze occurs. In addition, an eye-tracker would allow for the labeling of the object to only occur if the infant is looking directly at the object. The use of an eye-tracker would also simplify the post-hoc coding of look durations and frequencies to specific targets as areas of interest could be isolated on the visual presentations.

Regardless of the means of presentation to the infant, the importance of speaker characteristics must be carefully considered in future studies. The face that provides the information to infants must be dynamic, contingent on the looking of the infant and include indications to the infant that the information to follow is for them, beyond simple gaze shifts and infant-directed speech. Another ostensive cue category that has been demonstrated to help infants with difficult tasks is changes in emotion. Csibra and Volein (2008) demonstrated that infants would follow the gaze of a social partner to an occluded object if a woman made eye contact with the infants first, followed by a smile in their direction. An excited verbal reaction was also provided when her gaze shifted from the infant to the location of the hidden object. With this in mind, emotional changes and reactions can also provide infants with further information about how to direct their attention, even when the task is difficult. Minimal pair labels for objects might be one way to explore the value of these ostensive cues further. Overall, a dynamic face, whose mouth visually produces the labels for the objects, that engages in more overt gaze shifting (e.g., face moves to the side with the eyes) or other kinds of distinct facial changes should be central to the design of future studies.

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Figure 1

Study Hypotheses

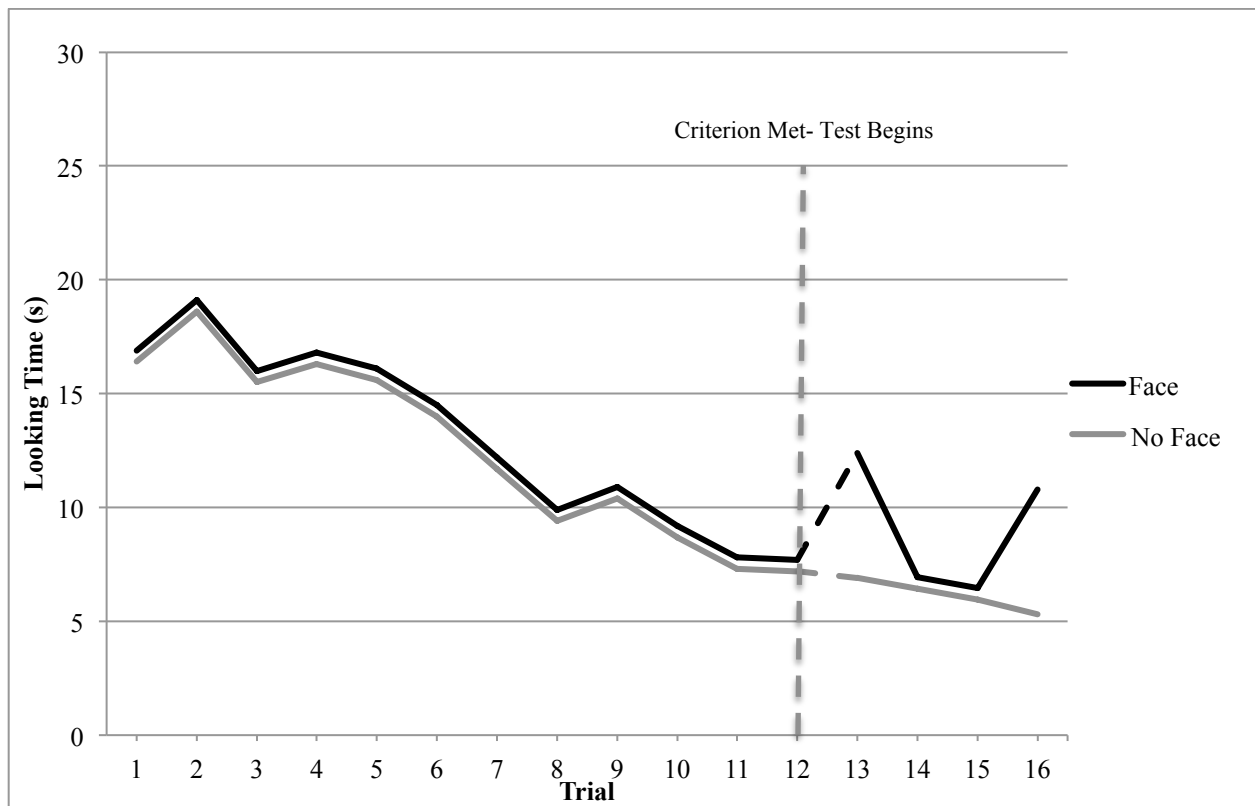
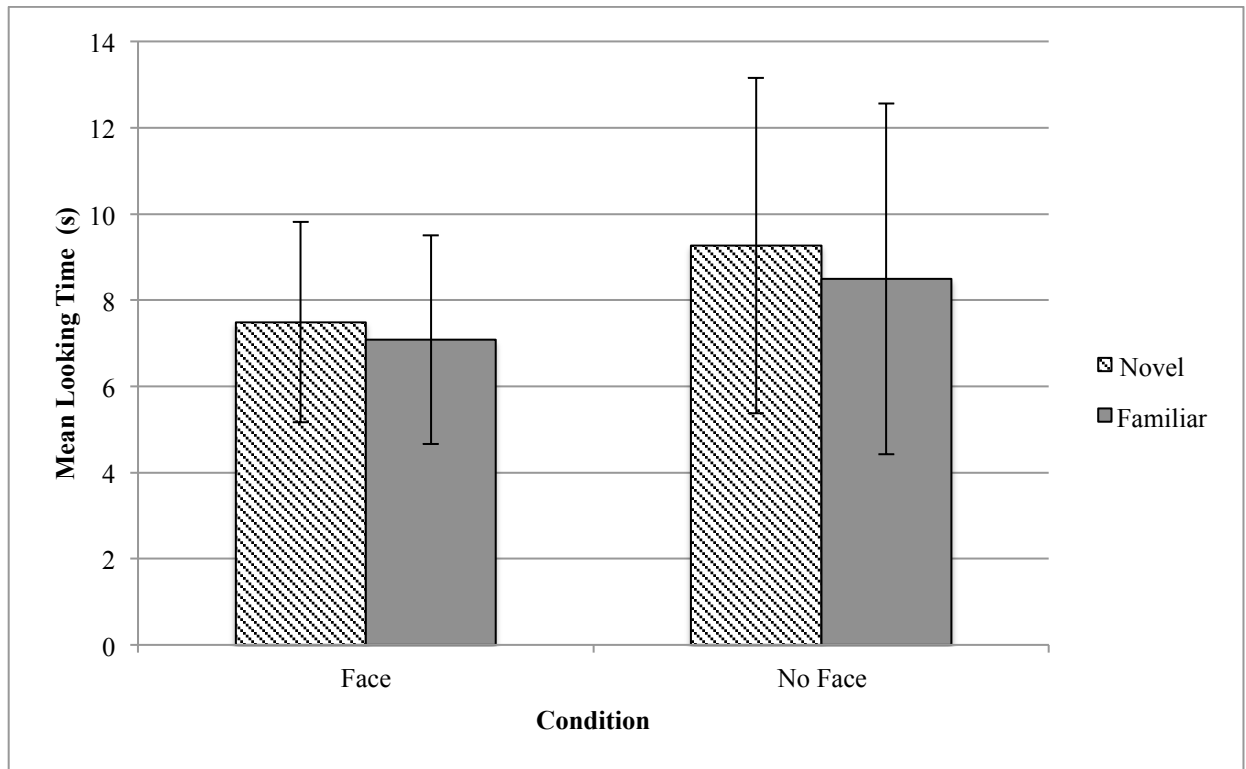


Figure 2

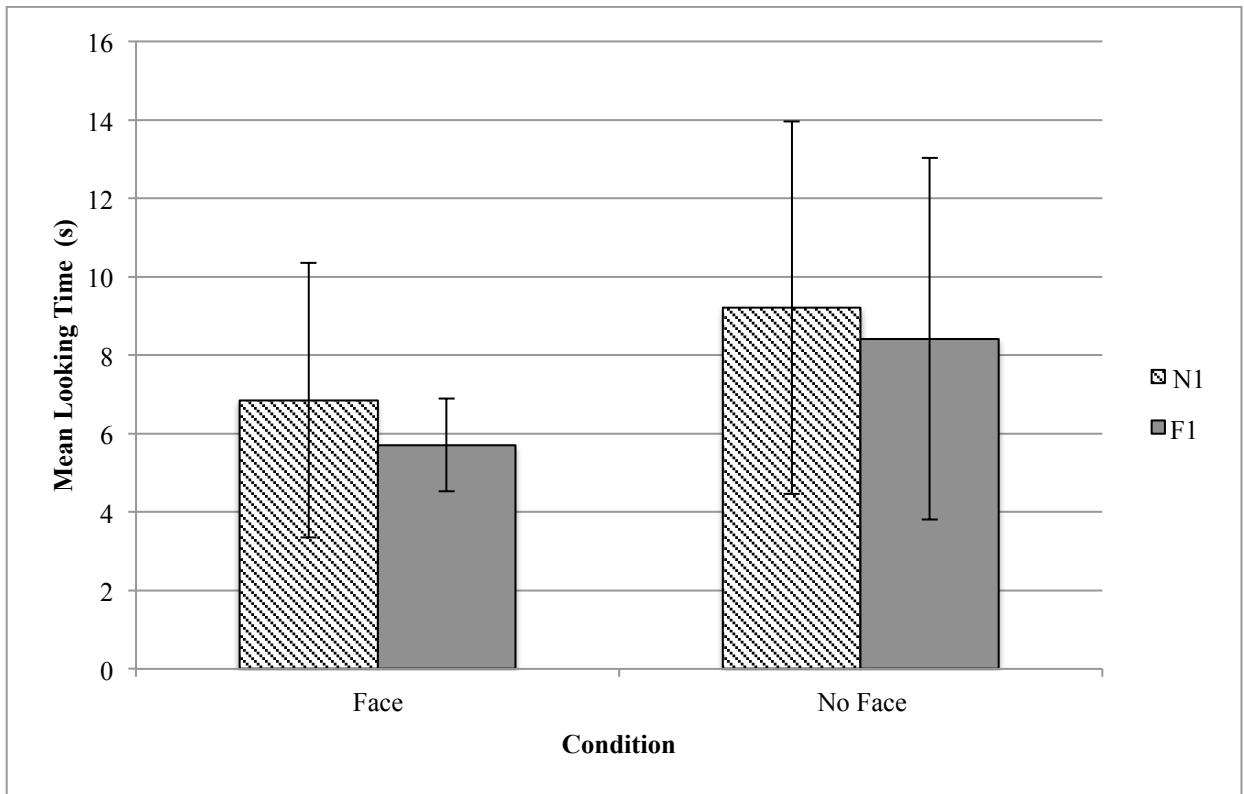
Mean Look Durations for Novel and Familiar Test Trial Means by Condition



Note: Standard deviations are also represented.

Figure 3

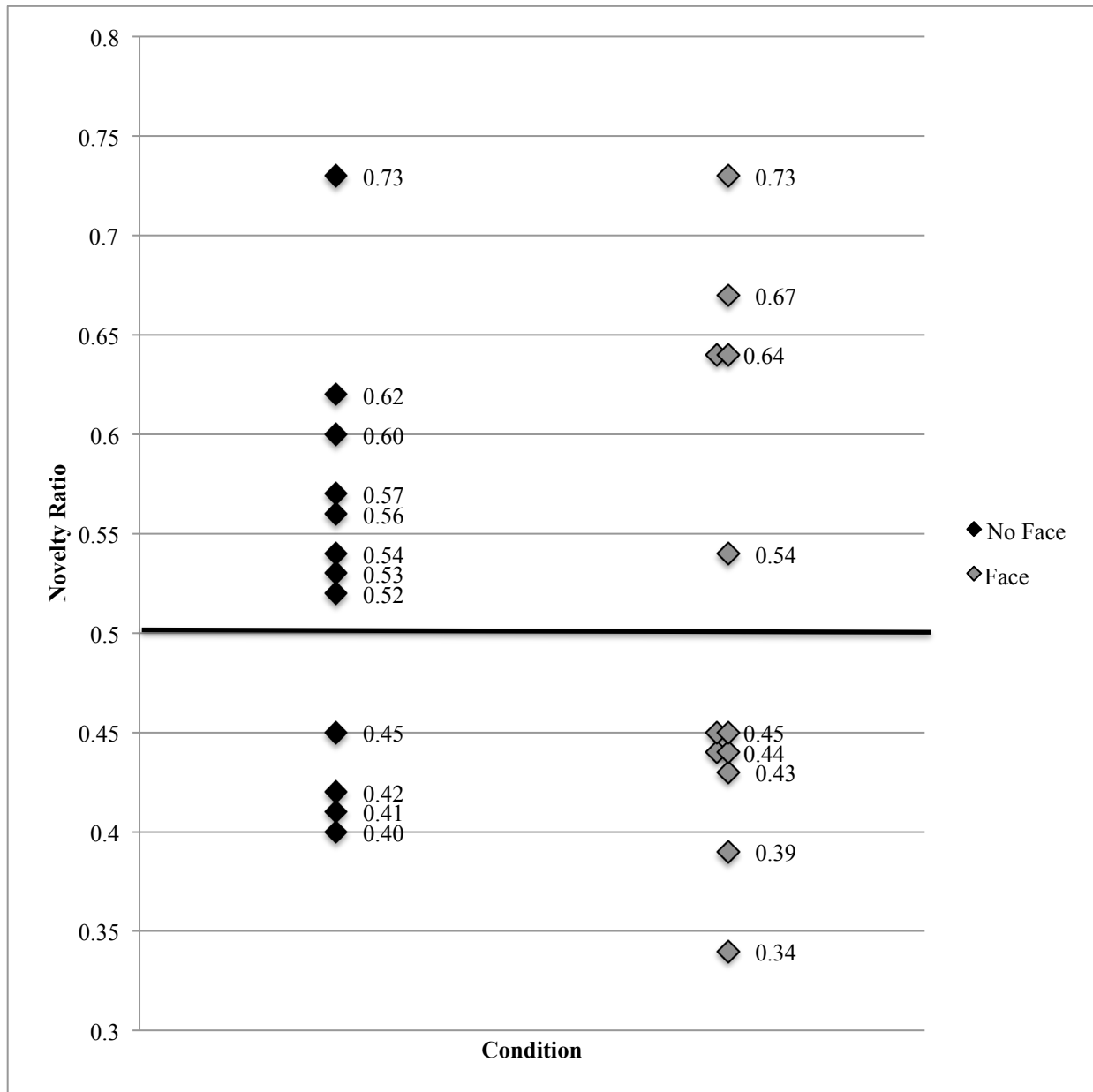
Mean Look Durations for First Novel and Familiar Test Trials by Condition



Note: Standard deviations are also represented.

Figure 4

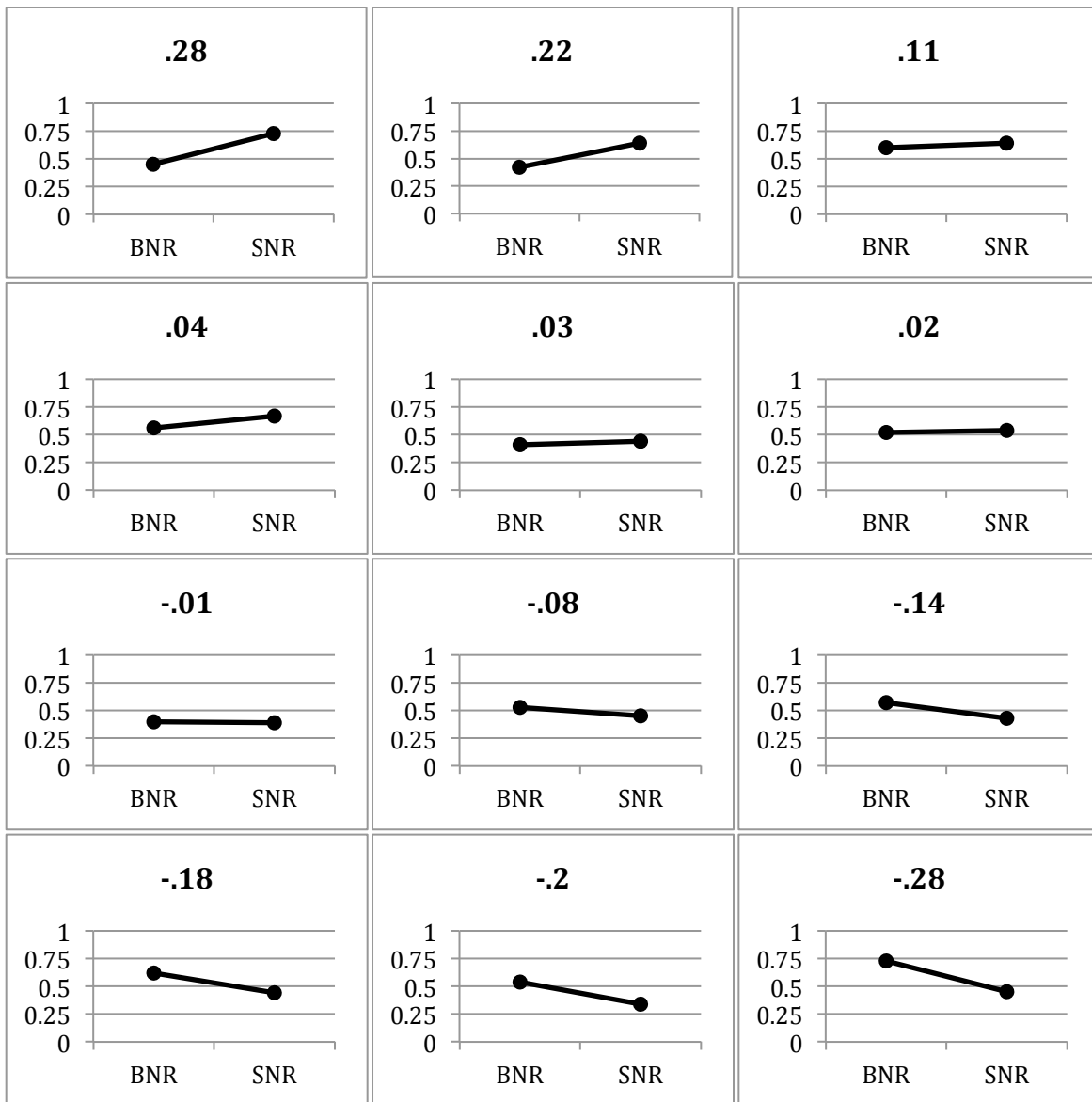
Novelty Ratios by Condition



Note: Novelty Ratio = Novel Mean/(NovelMean + Familiar Mean)

Figure 5

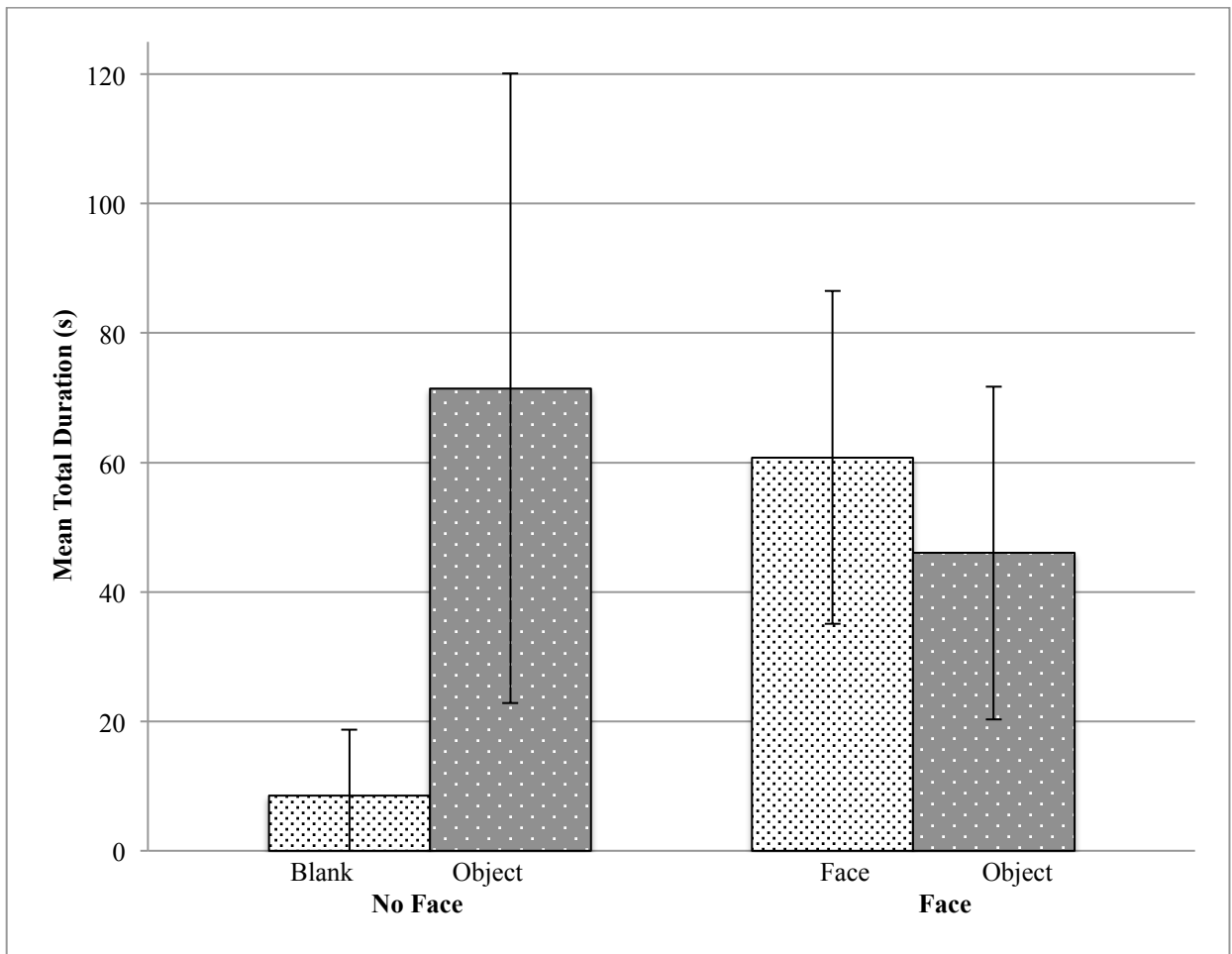
Individual Novelty Ratios Patterns



Note: The difference score is listed at the top of each cell.

Figure 6

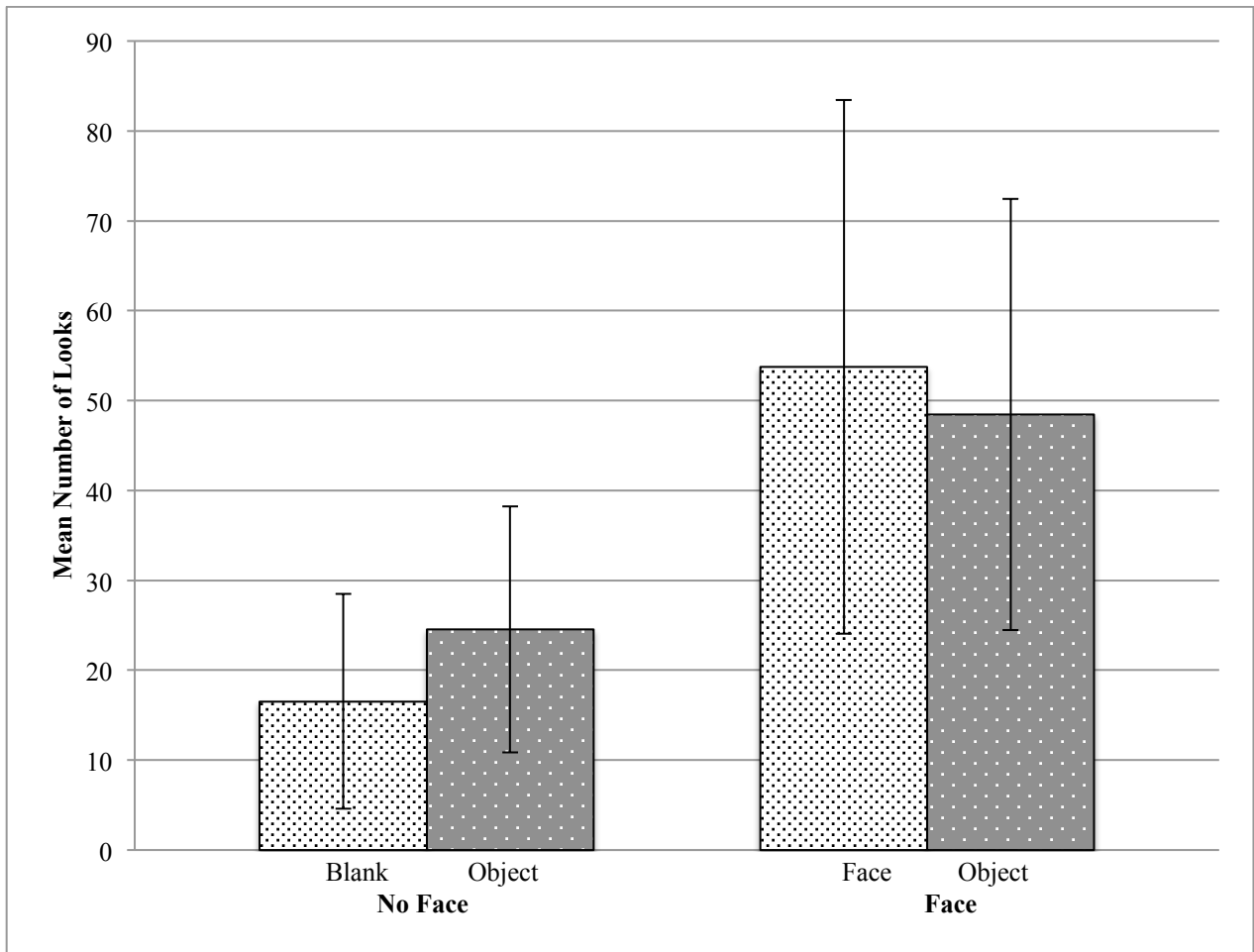
Mean Total Look Durations and Standard Deviations by Target and Condition



Note: Standard deviations are also represented

Figure 7

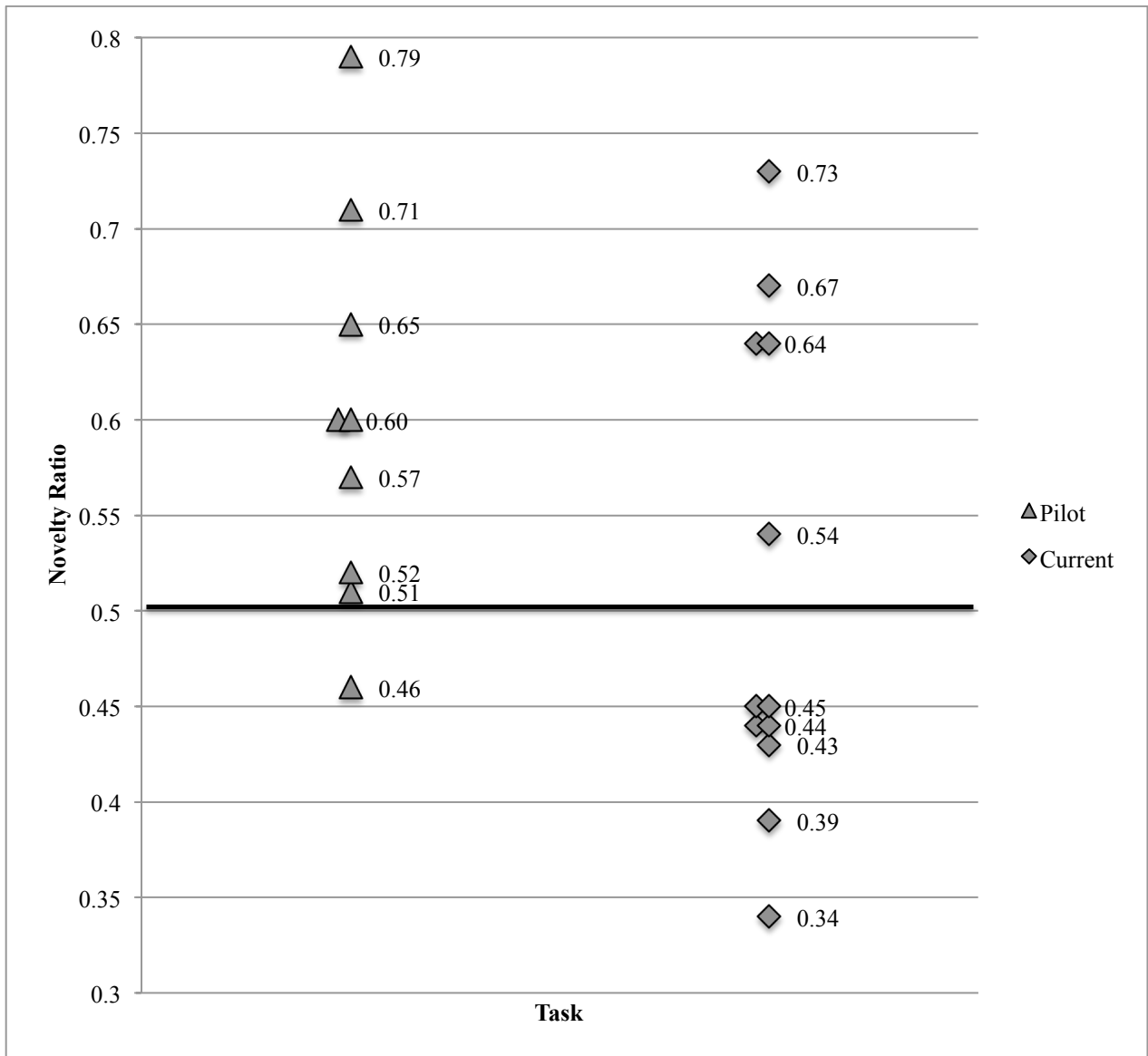
Mean Look Frequency and Standard Deviations by Target and Condition



Note: Standard deviations are also represented.

Figure 8

Novelty Ratios from Current and Pilot Study Face Conditions



Note: Novelty ratios for the face condition from the pilot experiment with labels were easily contrasted (e.g., “neem” and “boog”) vs. those for infants in the face condition from the experiment with minimal pairs (e.g., “bin” and “din”). Only novelty ratios from the easily contrasted pairs experiment were significantly greater than .50.

Table 1

Look Counts and Durations by Target and Condition for > .5 Sub-Group

	No Face	Face
	Counts	
Blank/Face	20.00 (18.00)	45.00 (16.81)
Object	15.60 (11.93)	40.20 (16.04)
	Durations	
Blank/Face	4.28 (3.45)	51.27 (24.88)
Object	73.90 (58.71)	47.06 (23.43)

Table 2

Look Counts and Durations by Target and Condition for $\leq .5$ Sub-Group

	No Face	Face
	Counts	
Blank/Face	14.14 (9.32)	43.14 (29.77)
Object	17.43 (8.42)	37.00 (27.91)
	Durations	
Blank/Face	12.46 (12.72)	66.40 (28.03)
Object	71.31 (49.03)	46.01 (36.96)

Table 3

Joint Attention Correlation Table

	Age	Gender	Mother Age	FatherAge	Mother Ed	Father Ed	Income	Birth Order	TV	Gestation	Birth Weight	Ear Infections	Vocab	Temp	No Face	Face	RJA	EC
RJA	.05	.55	-.47	-.29	-.23	-.08	.20	.17	.30	.33	-.01	.51	.57	-.29	.55	.20		
EC	-.05	-.20	.20	.41	-.30	.03	-.05	-.10	.30	.46	.40	.52	.19	-.02	-.02	.15	.34	

Note: *. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4

Questionnaire Correlation Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Age ¹															
Gender ²	.31														
Mother's Age ³	-.05	-.15													
Father's Age ⁴	-.11	-.25	.80**												
Mother's Education ⁵	-.46	.19	.11	-.19											
Father's Education ⁶	.26	.06	.58*	.43	-.09										
Family Income ⁷	.21	.45	-.21	-.08	.25	.26									
TV ⁸	-.38	.25	.15	.31	.19	-.12	.00								
Birth Order ⁹	.43	.34	.15	.33	-.51	.24	.09	-.29							
Gestation ¹⁰	.31	.23	.45	.44	-.53	.27	-.30	.23	.50						
Birth Weight ¹¹	.43	-.01	.62*	.51	-.54	.63*	-.23	-.19	.45	.72**					
Ear Infections ¹²	-.13	.10	-.12	.22	-.27	-.20	.13	.10	.39	.25	.16				
Expressive Vocab ¹³	.68*	.48	-.30	-.15	-.56	.24	.29	.04	.30	.32	.33	.05			
Temperament ¹⁴	-.19	-.35	-.10	-.12	.52	-.20	.08	-.15	-.46	-.71*	-.43	-.06	-.34		
No Face Novel Ratio ¹⁵	.43	.35	-.25	-.48	-.39	.08	-.35	-.15	.15	.45	.35	-.06	.54	-.40	
Social Novel Ratio ¹⁶	-.23	-.42	-.54	-.18	-.26	-.35	.06	-.32	.07	-.35	-.26	.62*	-.15	.28	-.15

Note: *. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

Appendix A

Demographics Questionnaire



Infant # _____

Experiment # _____

Infant Perception Laboratory

Family Information Sheet

(All information is strictly confidential)

Infant's Birthdate: _____ Mother's Age: _____ Father's Age: _____

Mother's Occupation: _____ Father's Occupation: _____

Mother's Education: High School Partial College College Master's Ph.D.

Father's Education: High School Partial College College Master's Ph.D.

Annual Family Income: \$10,000-\$20,000 \$20,000-\$35,000 \$35,000-\$50,000 \$50,000-\$65,000
 \$65,000-\$80,000 \$80,000-\$95,000 > \$95,000

Marital Status: Married Separated Divorced Unmarried/Single Widowed

Mother's Race: White/Caucasian African American Hispanic Asian Native American
Other _____

Father's Race: White/Caucasian African American Hispanic Asian Native American
Other _____

Has your infant had any medical problems? Yes No Please List: _____

Please list the birth date and gender of any older children:

_____ M F _____ M F
_____ M F _____ M F

Does your infant watch any TV.? Yes No Please list: _____

Has any child in the family been suspected of a developmental delay/diagnosis? Yes No

If yes, please describe: _____

How did you find out about our study? Letter Brochure Friend Lecture

Appendix C

Expressive Vocabulary Measure

Child Behavior Checklist- Language Development Survey (Ages 1.5-5)

Achenbach , T.M. Rescorla , L. (2000). Manual for the ASEBA preschool forms and profile.

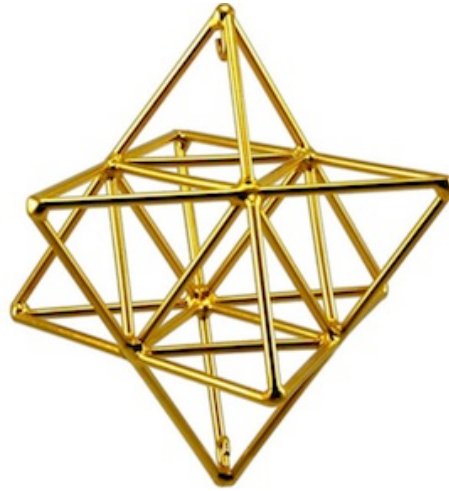
Burlington, VT: ASEBA.

Appendix D

Objects Used in Events



Black Points



Gold Sculpture



Green Elbow



Red Tool

Appendix E

Informed Consent for Questionnaires

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY Informed Consent for Participants in Research Projects Involving Human Subject

Title:

The Effects of Social Attention on Infants' Referential Learning

Principle Investigators:

Dr. Robin Panneton
Laura Mills-Smith

I. Purpose of this Research/Project

The purpose of this project is to investigate if infants' attention to faces assists in the learning of object labels.

II. Procedures

You will complete 3 questionnaires about your family and your infant. One questionnaire, the family information questionnaire, focuses on descriptive information about your family, the environment in which your infant is being raised, and developmental information about your infant. A second questionnaire, the Clinical Behavioral Checklist-Language Development Survey, asks for additional developmental information about your infant specific to language development and your infant's word knowledge and use. The final questionnaire, the infant questionnaire, asks questions about your infant's temperament.

III. Risks

There are no apparent risks to your infant or to yourself for participation in this study.

IV. Benefits

In addition for providing information to describe the sample of this study, the information from the questionnaires will also provide details about attributes of the infants and their communicative development that may be related to how they associate labels and objects as indicated by their performance on the switch tasks.

Although there are no direct benefits to the participants in this study, all parents will receive a summary report of the results of this project (a general analysis of all the infants). Parents will also receive a certificate of appreciation and the results of the study will contribute to a broader body of research on infants' social attention and language learning.

V. Extent of Anonymity and Confidentiality

Completed questionnaires will be kept separately from identifying information and stored in a locked laboratory room.

All of the information gathered in this study will be kept confidential and the results will not be released without parental consent. However, the results of this project may be used for scientific and/or educational purposes, presented at scientific meetings, and/or published in a scientific journal.

VI. Compensation

There is no compensation to be earned from participation in this project.

VII. Freedom to Withdraw

You have the right to terminate your infant's involvement and withdraw your questionnaire responses at any point in time and for any reason should you chose to do so.

VIII. Participant's Responsibilities

I voluntarily agree to have my infant participate in this study.

IX. Participant's Permission

I have been given an opportunity to ask further questions about this procedure and I understand that I have the right to end this session and withdraw my responses for any reason if I so choose. The Human Subjects Committee of the Department of Psychology and the Institutional Review Board of Virginia Tech has approved this project. If I have any questions regarding this research and its conduct, I should contact one of the persons named below. Given these procedures, I consent to complete the battery of questionnaires.

Dr. Robin Panneton, Principle Investigator	231-5938
Laura Mills-Smith, Graduate Student and Co-Investigator	231-3972
Dr. David Harrison, Chair, Human Subjects Committee	231-4422
David M. Moore, DVM, IRB Chair	231-4991

Signature of Parent: _____

Date: _____

Appendix F

Informed Consent for Infant Tasks

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY Informed Consent for Participants in Research Projects Involving Human Subject

Title:
The Effects of Social Attention on Infants'
Referential Learning

Principle Investigators:
Dr. Robin Panneton
Laura Mills-Smith

I. Purpose of this Research/Project

The purpose of this project is to investigate if infants' attention to faces assists in the learning of object labels. We will show your infant a variety of movie clips of women, with normal or scrambled faces, who look at objects, while your infant hears labels for the object. We are interested in how infants' responses to faces and social cues affect their ability to associate difficult words with objects.

II. Procedures

Your infant will be tested with three tasks, for a total of approximately 20 minutes. The baby will be seated on your lap. The infant will face a screen on which they will watch movies. First, the infant will see a smiling and laughing baby to attract their attention. Then the infant will see a series of movie clips of a women's face or mixed up fact looking at objects, while hearing labels for the object, interspersed with clips of the happy baby. The duration of your infant's looks to the screen will be measured. Following this task, the infant will engage in a fun interaction with an experimenter during which they will play with wind-up toys and look at posters together. Finally, the first task will be repeated with different movies. If for any reason, your infant cries or falls asleep, testing will advance to the next task or be discontinued as appropriate.

III. Risks

There are no apparent risks to your infant or to yourself for participation in this study. Sound

levels for all auditory stimuli will be verified prior to the testing of each infant.

IV. Benefits

Although there are no direct benefits to the participants in this study, all parents will receive a summary report of the results of this project (a general analysis of all the infants). Parents will also receive a certificate of appreciation and the results of the study will contribute to a broader body of research on infant social attention and language learning.

V. Extent of Anonymity and Confidentiality

All of the information gathered in this study will be kept confidential and the results will not be released without parental consent. However, the results of this project may be used for scientific and/or educational purposes, presented at scientific meetings, and/or published in a scientific journal.

VI. Compensation

There is no compensation to be earned from participation in this project.

VII. Freedom to Withdraw

You have the right to terminate your infant's involvement at any point in time and for any reason should you chose to do so.

VIII. Participant's Responsibilities

I voluntarily agree to have my infant participate in this study.

IX. Participant's Permission

I have been given an opportunity to ask further questions about this procedure and I understand that I have the right to end this session for any reason if I so choose. The Human Subjects Committee of the Department of Psychology and the Institutional Review Board of Virginia Tech has approved this project. If I have any questions regarding this research and its conduct, I should contact one of the persons named below. Given these procedures and conditions, I give my permission to Dr. Panneton, Ms. Mills and their co-workers to test my son/daughter.

Dr. Robin Panneton, Principle Investigator	231-5938
Laura Mills-Smith, Graduate Student and Co-Investigator	231-3972
Dr. David Harrison, Chair, Human Subjects Committee	231-4422
David M. Moore, DVM, Assistant Vice Provost for Research Compliance	231-4991

Signature of Parent: _____

Date: _____

Infant's Name: _____

I would like to be contacted by phone regarding future studies: YES NO

Appendix G

Experimental Condition - Face

Habituation:



Test-Switch Trials:



Test-Familiar Trials:



Appendix H

Experimental Condition – No Face

Habituation:



Test-Switch Trials:



Test-Familiar Trials:

