

Social and Nonsocial Priming Effects on 12- to 15-Month-Olds' Preferences for
Infant-Directed Speech

Tyler Christine McFayden

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Master of Science
In
Psychology

Robin K. Panneton, Co-Chair

Thomas Ollendick, Co-Chair

Susan W. White

John Richey

May 7, 2018
Blacksburg, Virginia

Keywords: priming, infants, IDS, language, attention, attention getter, perception

Social and Nonsocial Priming Effects on 12- to 15-Month-Olds' Preferences for
Infant-Directed Speech

Tyler Christine McFayden

ACADEMIC ABSTRACT

In adults, the availability of certain kinds of cues prior to a recognition task facilitates performance (often called “priming”). Studies have found that conceptual and perceptual priming improves neural efficiency and thus shortens response time in adults. In infant research, various visual and auditory/visual events are used as attention getters to orient the infant to a screen and alert them to upcoming information for their detection, discrimination, and/or recognition. However, the influence of attention-getters on infants' performance has rarely been systematically evaluated, even though these attention cues could be acting as perceptual/conceptual primes. This study investigated the effect of priming on infants' preferences for infant-directed speech (IDS) compared to adult-directed speech (ADS). IDS, an inherently social event, can be described as a moderator between attention systems and later language development. Thus, if the attentional network is primed in advance of hearing IDS, it is possible that the magnitude of the IDS preference may change. In this study, 20, 12- to 18-month old infants were provided with either a nonsocial or social prime in an infant-controlled, speech preference procedure with both IDS and ADS speech types. The infant's total looking duration to IDS relative to ADS was compared for the social versus nonsocial prime condition. Results indicated a main effect for speech and overall IDS preference. However, no significant effect of

prime was detected. Results are discussed in terms of future directions to investigate social priming of language in infancy.

Social and Nonsocial Priming Effects on 12- to 15-Month-Olds' Preferences for
Infant-Directed Speech

Tyler Christine McFayden

GENERAL AUDIENCE ABSTRACT

In infant research, short duration events are used before the task of interest to orient infants to the screen, increase their attention, and prepare them for the following information to come. These events are called “attention getters” in developmental research, and are used internationally as a way to garner infants’ attention before the main test of interest. Labs use different attention getters based on their prior experience of what works best, and these attention getters vary in content (e.g., social, nonsocial), and format (e.g., audio, visual, audiovisual). The effect of the content of the attention getter on infants’ subsequent performance has never previously been studied, although the content could be acting as a *prime* for the following task. This study investigated the effect of a social, as opposed to nonsocial, attention getter on infants’ subsequent performance on a speech preference task. Infants (N = 20, 12- to 18-month olds) received both infant-directed speech (IDS; or how caregivers speak to their infants, characterized by shorter sentences, slower rate of speech, and exaggerated vowels) and adult-directed speech (ADS; or how adults speak to other adults, characterized by complex grammar, faster rates of speech, and shorter vowel sounds) which were preceded by either a social (woman saying “Hi Baby” in IDS) or nonsocial (swirling target with chimes) attention getter to investigate their preferences for speech type. It was predicted that infants who received a social prime would demonstrate a stronger preference for IDS over ADS

relative to infants who received the nonsocial prime. Results indicated a main effect for speech and overall IDS preference. However, no significant effect of attention getter was detected, and the interaction between speech type and attention getter was not significant. Thus, our predicted results were not supported; the content of the attention getter did not attenuate or augment infants' speech type preferences. Results are discussed in terms of future directions to better detect social priming in infancy.

Table of Contents

<i>Page Number</i>	<i>Section</i>
1	Introduction
15	Methods
19	Results
22	Discussion
29	References
36	Tables
37	Figures
38	Appendix A
39	Appendix B
41	Appendix C
42	Appendix D
49	Appendix E

Social and Nonsocial Priming Effects on 12- to 15-Month-Olds' Preferences for Infant-Directed Speech

Developmental research with infants and young toddlers uses multiple behavioral approaches, ranging from habituation/familiarization procedures, preferential looking paradigms, and eye tracking, to name a few (see Johnson & Zamuner, 2011). While the empirical intentions of these strategies differ, one element of conducting research with young human subjects remains the same: researchers need infants' attention and cooperation. One primary way researchers meet this goal is through the systematic use of "attention getters", or short-duration stimuli designed to attract the infant toward some mid-point (e.g., the center of a screen) so a trial can commence with attention in place. Inadvertently, attention getters may serve an important and understudied role in infant research: they may augment or attenuate infants' perceptual/cognitive preparedness to process the information that is yet to come. In this sense, events that developmental scientists include in their protocols to keep infants focused on screens may also be affecting selective attention, processing, and memory in the task itself. Attention getters may be, in fact, *priming* infants' information processing. However, little explicit experimental work has been conducted that looks at the choice of attention getter on learning outcomes during infancy and early toddlerhood.

Interestingly, a wide variety of attention getters are used throughout the infant literature, ranging from stimuli with simple configurations (e.g., a fixation cross, a flashing light, a black and white checkerboard) to ones with more complex attributes (e.g., a video segment, a multicolor geometric display, a laughing baby). As these descriptions make clear, the varied choices of attention getters incorporate multiple modalities: visual and auditory-visual (A/V), as well as content (i.e., objects v. faces) and movement (i.e., static v. dynamic). Of particular

relevance to this project, attention getters can also have a social (person-oriented) or non-social (geometric) nature. Of central interest here is whether the choice of these attention-promoting events actually impacts subsequent information processing in certain systematic ways?

Attention getters, as the name suggests, are crucial for engendering behavioral and neural activation of infants' attention in developmental research. For example, Domsch, Thomas, and Lohaus (2010) presented 6-month-old infants with either a blank screen or a colored dot that grew in size concurrent with a toy sound before the presentation of a habituation sequence (a checkerboard with dynamic elements). These authors found that infants showed greater heart rate decelerations (indicative of increased sustained attention; Richards, 1987) at the beginning of the habituation trials if they experienced the attention-getter. Moreover, infants who first viewed the attention getter also showed shorter looking time during habituation (indexing more efficient processing; Colombo & Mitchell, 1990), and increased dishabituation (indexing better discrimination) to a novel checkerboard. Domsch et al. (2010) concluded that an attention getter not only redirects an infant's gaze towards the screen, but also changes general arousal of the infant, facilitating analysis and encoding of subsequent information. These attention stimuli therefore serve a greater purpose than purely orienting, but it is not well known whether the type of stimulus can cognitively strengthen an infant's tendency to process, represent, and/or retrieve specific information (otherwise known as *priming*; Wang, 2011).

Priming and brain-behavior relations

“Priming” is defined as a non-conscious (i.e., not in one's awareness) change in an individual's ability to identify, produce, and/or classify some bit of information (e.g., a word) based on previous experience with related information (Schacter, Dobbins & Schnyer, 2004; Tulving & Schacter, 1990). There are two main types of priming: perceptual and conceptual

priming. Perceptual priming is seen in adults when they are quicker at naming and identifying stimuli they have previously seen than they are new stimuli (Wiggs & Martin, 1998). For example, given a list of words including “umbrella”, adults would be quicker to identify “_ _ B_ R_ L_ _ A” than a word they had not previously seen, such as “_ O _ Q _ I _ O” (mosquito). Perceptual priming tasks such as the one described above have been researched extensively with adults and have demonstrated long-lasting effects. Cave (1997) found that perceptual priming in a picture-naming task improved adults’ naming performance up to 48 weeks after the first exposure to the prime. Perceptual priming effects have even remained visible in the absence of conscious perception, as indicated by Kihlstrom and Schacter (1990), who presented auditory stimuli to patients under anesthesia. As a result of the anesthesia studies, perceptual priming is hypothesized to be distinct from any other form of memory, including episodic or procedural systems.

Behaviorally, perceptual priming is evidenced by shorter reaction times in standard naming procedures or improved identification of degraded stimuli (Schacter & Buckner, 1998). Considering the same example as mentioned above, adults who have been perceptually primed would be quicker to identify partial words if they have previously seen them than if they were novel. Neurophysiologically, this phenomenon expresses itself in reduced haemodynamic responses in the primed conditions relative to the novel conditions as indicated by PET and fMRI studies (e.g., Henson & Rugg, 2003). This is a seemingly counterintuitive finding, as one would hypothesize that a faster reaction time would be connected to a heightened neural response (i.e., more cortical activation to primed targets). However, the exact opposite is demonstrated consistently across studies. To explain this counterintuitive finding, Wiggs and Martin (1998) proposed that repeating an image or word sharpens its cortical representation. This sharpening,

or honing, of an item's cortical representation results in a more efficient neuronal firing pattern (e.g., neurons previously firing as a result of the novel status of the task are no longer active). As a result, the neuronal activation pattern appears to be more specific and less diffuse, referred to as response suppression, which, in turn, results in a decrease in the haemodynamic response from relevant brain region(s) (Henson & Rugg, 2003). For example, when first processing the word "umbrella", you may have an expansive neural firing pattern, as your brain is not sure which resources to recruit to complete the task. However, after seeing "umbrella" several times, patterns of neural activation are coupled with those of inhibition, reducing some of the extra activation that occurred the first time the word was presented. This increase in efficiency results in a net decrease in the haemodynamic response. It is a similar pattern as observed when one is playing a new video game (i.e. a lot of neural activation), compared to when you are an expert at that video game (reduced neural activation; Prakash et al., 2012). Taken together, behavioral and brain response patterns suggest that perceptual priming increases processing efficiency, making one an "expert" in that particular processing pattern.

The second type of priming, conceptual priming, does not deal as much with the physical properties of the stimulus, but the semantic properties (Tulvin & Schacter, 1990). For example, if you are asked to think of types of weather, and you are primed with "umbrella", you will be quicker to name "rain" and "thunderstorm", than you will "snow" or "sun". This type of priming involves the semantic meaning of the pre-stimulus that brings that semantic category to the front of your perceptual awareness. Conceptual priming is hypothesized to be completely distinct and separate from the underlying mechanisms of perceptual priming. Several studies have demonstrated the distinct patterns at play here, including a study of college students where dissociations were seen between performance on conceptual and perceptual priming (e.g.,

Blaxton, 1989), and studies involving amnesic patients who have no episodic memory (and therefore no perceptual priming) yet still benefit from conceptual priming (e.g., Schacter, Harbluk, & McLachlan, 1984).

Although both forms of priming have been studied frequently in adult populations, these priming mechanisms have not been studied in infancy. Furthermore, the adult evidence of conceptual priming suggests that if infants are presented an attention getter that activates a particular semantic network, their performance on a task that taps that same semantic network could be affected.

Priming affects multiple systems

The effects of perceptual and conceptual priming on adults are clear through behavioral response tasks and neural imaging tasks, as described above. In much younger participants, as evidenced by the work conducted by Domsch, Thomas, and Lohaus (2010), including an attention getter, or a prime, resulted in several behavioral and physiological changes compared to no prime conditions. By breaking down each ramification of including an attention getter on an infant's overall performance, it is possible to better understand what systems are involved when an infant is "primed".

First, infants who received a prime before habituation trials demonstrated greater heart rate decelerations, which is indicative of sustained attention. For infants, heart rate changes (decelerations and accelerations) have been used to indicate attention for a single look or an entire trial duration. Previous research conducted by Richards and colleagues has demonstrated that during the onset of an event, there is an initial deceleration in an infant's heart rate, indicating "stimulus orienting", or that the infant has been redirected to now attend to something new. After the initial deceleration indicating orientation, continued deceleration indicates

sustained attention. Once the infant has ceased paying attention, heart rate typically accelerates and returns to pre-stimulus levels, otherwise known as attention termination (Casey & Richards, 1988; Lansink & Richards, 1997; Richards, 1979). Thus, by including an attention getter at the onset of a trial, the attention systems of the infant are affected and altered, as indicated by measurements of heart rate.

Second, infants who received a prime also demonstrated shorter looking time during habituation trials relative to their non-primed peers, which is indicative of increased information processing. Although shorter looking time may intuitively infer less attention, the inverse is actually true: infants who are “shorter lookers” tend to have more efficient information processing systems relative to “long looker” infants (Colombo, Mitchell, Coldren, & Freeseaman, 1991). The short versus long looker research has demonstrated consistently that some infants are long lookers, meaning they fixate on events for a long duration while taking in featural details, and other infants are short lookers, meaning they fixate for shorter durations and take in more global information (Colombo & Mitchell, 1990). Colombo et al. (1991) report that short looking infants consistently perform better than their long looker peers on cognitive and perceptual tasks. Frank, Colombo, and Saxon (1999) posit that the differences between short and long lookers are a result of developmental and individual differences in the attentional and information processing systems. These systems control the infant’s ability to regulate attention, disengage, inhibit visual fixations, and process the information contained in the event. So when a prime or an attention getter results in shorter looking time for infants (compared to no attention getter), these primes are influencing both the attentional networks and the information processing systems of the individual viewing the events. Not only is the attention getter influencing and modulating the infant’s attention systems, but it is also contributing to their information processing systems.

As demonstrated above, it is clear that the attention getters used in infant research affect both the attention and the information processing systems. It may be that the attention getter activates the attention network in the infant, which in turn affects the information processing system. The attention system, as the potential mediator between the stimulus and information processing, may be similar to the types of perceptual or conceptual priming seen in adults; it simply has not been viewed in this manner before.

Behavioral and neurophysiological evidence for priming effects in infancy

The priming literature with infants is sparse although there is some support that infants as young as six months of age can be cognitively primed on particular tasks. In the context of word segmentation, Bortfeld, Morgan, Golinkoff, and Rathbun (2005) demonstrated an auditory priming effect in which infants differentially attended to and subsequently recognized lexical information that appeared adjacent to the word “Mommy” in sentences. Presumably, the word “mommy” primes attention due to its high familiarity. In fact, when replaced with “Tommy”, this effect disappeared. Bortfeld et al.’s (2005) research demonstrates that young infants can be cognitively primed to pay more attention to some stimuli more than others, especially when perceived to be relevant to their world.

Visual priming with infants has also been demonstrated in a series of studies looking at conjugate reinforcement effects in early development. In a series of classic studies, Rovee-Collier and colleagues demonstrated that infants as young as 3-months of age could retrieve visual information about a learning experience over a long retention interval provided that they experienced priming at shorter regular intervals (DeFrancisco & Rovee-Collier, 2008).

Visual color priming has been evidenced in 7.5-month-olds (Wilcox & Chapa, 2003). These authors first tested infants to see whether they would differentiate objects based on color,

for instance a cup or a ball. Pretest results indicated that infants looked equally at two objects of different colors, indicating no preference for a color or no differential attention. Wilcox and Chapa (2003) then demonstrated their ability to train infants to be primed by color. They provided exemplar trials to the infants in which the color of the object indicated its function. For example, a red cup always was a “pounder” that hit objects, and a green cup was always a “scooper” that could scoop sand or water. During these exemplars, the colors always remained the same and differentiated objects in terms of function. During the test trials, Wilcox and Chapa demonstrated that infants differentiated between a green and red ball after being primed by color and trained to learn that color implied function of an object. Wilcox and Chapa further concluded that infants could be primed by color to learn functions more readily, demonstrating cognitive priming.

Wilcox, Hirshkowitz, Hawkins, and Boas (2013) conducted a follow-up study to the one discussed above by Wilcox and Chapa (2003) to investigate the cortical underpinnings of the color priming task in 7- to 9-month-old infants. Brain imaging using functional near infrared spectroscopy (fNIRS) and behavioral data via habituation procedures were collected. Wilcox et al. (2013) employed three different pretest measures: a color measure (as used previously, to prime infants to attend to color), a motion measures (viewed as the “baseline” measure, not intended to prime for color), and no pretest measures. During the behavioral habituation procedures, only infants who received the color pretest were able to demonstrate object individuation based on color, replicating previous results. However, the neuroimaging results provided additional detail beyond the behavioral data. The infants who received a color pretest demonstrated greater activation in the anterior temporal cortex, which is hypothesized to represent object individuation.

The unexpected results, as described by Wilcox et al., were that the infants who had viewed any pretest event, both motion and color, demonstrated increased activation in the posterior temporal cortex relative to the infants who did not experience a pretest event. Wilcox et al. concluded that although the behavioral priming was not evident, receiving a pretest event influenced the processing of an event at the neural level. A potential explanation for the neural activation as a result of any pretest event is that the activation in the cortices act on a hierarchical level. That is, seeing any pretest event cues the infant to be on alert and activates the posterior temporal cortex. However, seeing a pretest event that reliably predicts and/or is connected to the test event activates a hierarchically superior system, the anterior temporal cortex, which cues the infant to change its behavior. Although just a preliminary hypothesis not yet supported by research, the findings of Wilcox et al. (2013) demonstrate that there may be more to priming than just evidenced in behavioral measures.

Social and non-social priming in infants?

Aforementioned literature has demonstrated the feasibility of behaviorally and neurologically priming infants. However, the experiments discussed thus far have included mostly nonsocial events such as checkerboards and object motor actions, which may be targeting perceptual priming. For this project, I am also interested in the semantic nature of the prime; whether a social prime “wakes up” social networks similar to how “umbrella” activates rain-based semantic networks in conceptual priming in adults. Does the social nature of the prime influence the behavioral outcome in infants?

One important challenge in addressing this question comes when defining what constitutes a “social” prime or event. Although most agree that social can be defined as having to do with other people, what does this mean for counting speech, smiley faces, or cartoons as

social? Colombo and Salley (2015) define “social” information as both having to do with another person plus the cues that the person conveys in interaction. For example, if another person turns their head to fixate on an object, “social” attention includes both looking at that person, and looking toward the object using their gaze path. In a recent review of the attentional literature, Salley and Colombo (2016) provide evidence that social cues engage behavioral and neural mechanisms differently than nonsocial cues (also see Colombo & Salley, 2015). These social contexts evoke specific activation patterns in the superior temporal sulcus, the fusiform gyrus, the amygdala, the prefrontal cortex, and the mirror neuron system, which collectively comprise the “social brain”. These areas are repeatedly and preferentially involved in the processing of social information, which may lend more evidence to there being something unique about social information processing in infancy (Colombo & Salley, 2015; Johnson, 2010; Kuhl, 2007). Social attention, a seemingly distinct construct from general and nonsocial attention, may provide an interesting platform on which to investigate priming effects in infancy.

Several developmental researchers have included social elements in their tasks with infants. For instance, Brower and Wilcox (2013) investigated the effect of a social or nonsocial context in a color-priming task. When presenting infants with events, Brower and Wilcox differentiated objects’ functions as a result of color. For example, a green cup was used to hit a peg, and a red cup was used to scoop sand. For other events presented to the infant, green items were always used to hit while red were always used to scoop. Previous studies had indicated that when presented with this information, infants would then give differential attention to a red versus green ball, indicating color had primed them to infer different functions (i.e., Wilcox & Chapa, 2004). Brower and Wilcox’s main goal in this paradigm was to investigate visual priming in two different contexts: social, as defined as having at least one human present in the task, and

nonsocial, defined by having only objects present. Brower and Wilcox demonstrated that color priming can occur in older infants (9.5 months) in both nonsocial and social contexts. However, when working with younger infants (8.5 months), they only demonstrated color priming in social contexts. The youngest infants tested (7.5 months), only demonstrated a color priming effect in a social context when the human present was a parent, opposed to a stranger. Brower and Wilcox's data highlight a few key findings: (1) the importance of infant age in testing priming, (2) the potency of social contexts, and (3) the importance of investigating social priming further, as it appears to be distinct from nonsocial priming.

Over and Carpenter (2009) included degrees of "socialness" in their tasks, which involved presenting infants with a picture of a teakettle with a subtle prime in the background: two dolls, one doll, or blocks. Four stacked blocks served as a baseline, or nonsocial condition. The one doll condition served as a social "individual" condition. The two doll conditions had two variations: an affiliation condition, where the two dolls faced each other, or a back-to-back condition, where the dolls were facing opposite directions. Over and Carpenter were interested in whether the degree of the social nature of the prime would differentially predict the toddler's spontaneous helping behavior when an experimenter dropped some of her materials. The toddlers who were primed with the affiliation condition engaged in more pro-social helping behavior more spontaneously, compared to toddlers the three other conditions. There was no significant difference in the nonsocial, individual, or back-to-back condition in terms of pro-social helping behaviors.

These results demonstrate that toddlers are attuned to social information, and that the presence of social information, even when included in the background of an image, can alter their behaviors. These results may demonstrate that even seeing a background image that evokes

neural activity in the social semantic networks creates behavioral ramifications in terms of social behaviors. Over and Carpenter's (2009) results may be one of the first studies to demonstrate a response equivalent to the shortened reaction time reported in adults who were successfully primed.

Modulating speech preferences via social and non-social primes

In order to begin an investigation of the effects of priming on infants' information processing, we need to identify a cognitive task that is both relevant to infant development and amenable to moderation by levels of attention. Infant-directed speech (IDS) describes the vocal style that many caregivers use when addressing an infant across multiple cultures. Adult-directed speech (ADS), on the other hand, describes typical vocal styles adults use when communicating with each other. IDS, compared to ADS, has greater amplitude and frequency modulations, higher fundamental frequency (pitch), shorter duration, and often involves verbal repetitions, among other notable differences (Cooper, Abraham, Berman, & Staska, 1997; Fernald et al., 1989).

A large body of literature has investigated and reported on infants' preferences for IDS over ADS, spanning multiple age ranges, testing paradigms, and cultures (e.g., Kitamura & Lam, 2009; Santesso, Schmidt, & Trainor, 2007; Werker & McLeod, 1989). For example, Cooper and Aslin (1990) investigated the IDS preference in 2-day-olds and 1-month-olds and found that both age groups demonstrated a behavioral preference for IDS relative to ADS. Neurophysiologic evidence also points to a relationship between IDS and heightened infant attention, demonstrated by decreases in heart rate, increased neural connectivity in the frontal-temporal lobes in EEG (Santesso, Schmidt, & Trainor, 2007), and adult-like mismatch negativity responses in ERP studies (Peter, Kalashnikova, Santos, & Burnham, 2016).

Infants' preference for IDS is hypothesized to be related to later language acquisition. Several researchers have demonstrated the predictive nature of attention to IDS to later language comprehension and acquisition (e.g., Christia, 2013). For example, Thiessen, Hill, and Saffran (2005) demonstrated that ID speech, but not AD speech, contributed to word segmentation in a preferential listening paradigm, and Vouloumanos and Curtin (2014) reported that attention to speech at 12 months, but not measures of attention to non-speech, predicted language development at 18 months of age. Given the above information, an infant's IDS preference could be described as a mediating mechanism between attention and language development. Because IDS preference is modulated by attention, choosing this particular IDS/ADS preference task to investigate priming is advantageous. By using a prime to investigate how attention is regulated, we could also learn how preference for IDS is affected or changed.

Importantly, there is natural variation in infants' preference for IDS, which will allow priming mechanisms to potentially alter outcomes. Not all subgroups of infants show strong preferences for IDS, such as infants at-risk, and toddlers with autism spectrum disorders. For example, Droucker, Curtin, and Vouloumanos (2013) investigated the IDS preference in siblings at risk for developing ASD and reported that typically-developing (TD) infants demonstrated an IDS preference at 12-months of age, whereas at-risk infants did not show an IDS preference until at least 18-months of age. Furthermore, at-risk infants' attention to IDS did not predict language outcomes as it did in TD infants. These authors concluded that not all infants demonstrate a preference for IDS, nor does a preference mean the same thing in terms of language outcomes for all children.

IDS preference, a robust finding in the infant literature yet with variability in degree of preference, provides an excellent methodological platform to investigate perceptual and

conceptual priming in infants. IDS preference is highly modulated by the attention system of the infant. By providing infants with particular social or non-social primes, the attention system that determines an infant's preference has the opportunity to be affected. If preference for IDS over ADS, a fairly frequent finding in all infant studies, can be affected by priming, this creates an interesting and convincing argument for the effects of priming on infant's information processing, attention, and language systems.

Current study

The infant –Language Emotion Attention Perception laboratory is currently taking part in a nation-wide IDS/ADS preference study. As a result, we are taking advantage of this interesting methodological question to contribute additional data to the literature: the effects of priming (social v. non-social) on infants' preference for IDS versus ADS speech. The IDS/ADS preference paradigm creates an interesting platform on which to explore the effects of priming, as both priming and speech preference procedures involve the attention and information processing systems. Furthermore, the question of conceptual priming- activating a semantic network- can also be addressed, as IDS is inherently a social event. Most attention getters throughout infant research are used simply to orient the infant towards the center of the screen. A stimulus as simple as a dot can be effective for this goal. However, the information that is conveyed through the attention getter prime has rarely been systematically studied, nor has attention been paid to the relationship between the prime and what event or information is about to come. By manipulating the social nature of the prime, questions about conceptual priming in infancy can be addressed. For this study, we investigated whether presenting infants with a social prime can attenuate or alter infants' preferences for speech. We hypothesized that presenting

infants with a social prime would increase preference for IDS over ADS speech relative to when primed with a nonsocial stimulus.

Methods

Participants

Twenty infants between the ages of 12-18 months were recruited to participate in this study ($M_{\text{age}} = 14.5$ months, $SD_{\text{age}} = 1.64$, 13 females). An additional 5 infants were recruited but excluded due to fussiness ($N = 3$), prematurity ($N = 1$), or developmental delay ($N = 1$). For demographics by condition, see Table 1. The demographic characteristics of the sample were representative of the geographic recruitment area in terms of race and socioeconomic status. Families were recruited from advertisements in local magazines, family-friendly publications (i.e. “Macaroni kid”), Virginia Tech listservs, and recruitment efforts during popular events held throughout the community. Parents were compensated \$20 for their child’s participation.

Measures

Demographic questionnaire. The demographic questionnaire (Appendix A) is an iLEAP lab standard series of questions including gender, maternal education level, birth order, and race/ethnicity.

MacArthur-Bates Communicative Development Inventories- Short Form Level I (MCDI). The MCDI (Appendix B) is a parent-report instrument assessing a child’s expressive language abilities. Part 1 of the words and gestures short form (Level I) used here is normed for infants ages 8-18 months and evaluates an infant’s speech and language production. This measure consists of a 396-item vocabulary checklist divided into 19 semantic categories. The MCDI has established reliability and validity in multiple studies and with a variety of typical and atypical populations, including preterm (Dale et al., 1989), cochlear-implanted (Thal, Desjardin,

& Eisenberg, 2007) developmentally delayed (Miller, Sedey, Miolo, 1995), and clinical samples (e.g., Thal et al., 1999).

Infant Behavior Questionnaire- Revised (IBQ-R). The IBQ (Appendix C) is a parent-report form that contains statements and questions regarding their infant's temperament that parents report on using a seven-point Likert scale. The IBQ is designed to measure temperament in infants between the ages of 3-12 months and assess multiple dimensions of temperament including, but not limited to: activity level, fear, sadness, orienting, soothability, distress, vocal reactivity, and smiling/laughter (Gartstein & Rothbart, 2003). Although normed on a sample of 3- to 12-month-olds, the IBQ is also an appropriate measure for infants older than 12 months. The IBQ has demonstrated excellent inter-rater reliability, construct validity, convergent and predictive validity, and longitudinal stability (Putnam et al., 2014).

Modified Checklist for Autism in Toddlers-Revised (MCHAT-R). The MCHAT-R (Appendix D) is a parent-report measure used to screen to Autism Spectrum Disorders in infants and toddlers ages 16-30 months. As the infants included in this study are younger (12-15 months), the MCHAT will be interpreted with caution and included as ancillary analyses. The MCHAT is not designed to be a diagnosis tool, but instead a screener to suggest additional evaluation for infants. As expected for a screener, the MCHAT and MCHAT-R have both been found to have high levels of sensitivity and lower levels of specificity, with approximately 48% of those with an elevated score being diagnosed with ASD at age three (Robins et al., 2013).

Experimental events

Primes. Infants were randomly assigned to receive one of two primes: a social or nonsocial centering stimulus. Both primes were dynamic video clips with auditory and visual components. The nonsocial prime was the standard centering stimulus created by the

ManyBabies project (Bergelson et al., 2017) and comprised a swirling target with changing colors and a musical audio track. This prime was deemed nonsocial due to the lack of people-oriented visual or auditory elements. The social prime comprised a female face making eye contact with the infant and verbalizing, “Hi Baby!” in infant-directed speech. This prime was deemed social due to its elements pertaining to a human face and voice (Senju & Csibra, 2008). Both of these events subtended 25° visual angle and were roughly the size of a typical adult human head from the vantage point of the infant observer.

Infant-directed and adult-directed recordings. The IDS and ADS audio tracks were created as a part of the ManyBabies project (Bergelson et al., 2017) and included 8 IDS tracks, and 8 ADS tracks. Each track contained multiple IDS or ADS utterances from a variety of different mothers that were matched for duration (21s) and RMS amplitude-normalized to 72dB SPL. For example, one IDS track contained six, unique utterances recorded from four female speakers. Each IDS and ADS track was unique, meaning the same utterance was never heard twice. Each IDS track contained utterances from four speakers and each ADS track contained utterances from three to four speakers. The number of clips per track varied, with IDS tracks having a mean of 6.88 clips per track and ADS clips having a mean of 4.5 clips per track. The difference in number of speakers and number of clips was a result of the naturally occurring variation between IDS and ADS (i.e., IDS utterances tended to be shorter in duration). The mean pitch of the IDS and ADS clips was 245.06 and 198.51 Hz, respectively. The IDS tracks fluctuated from a minimum pitch of 155.99 Hz to a maximum pitch of 436.03 Hz. The ADS tracks have a minimum pitch of 125.45 Hz and a maximum pitch of 448.25Hz.

Procedure

Infants and parents were seated in a playroom to complete informed consent and to serve as a warm-up period for the infant. Parents of participants provided informed consent for their infants. Informed consent and procedures were approved by the governing IRB (see Appendix E).

Infants then participated in the infant-controlled preference procedure during which they were given opportunities to listen to sequences of IDS and ADS recordings while viewing a colorful checkerboard. In this procedure, infants' attention to the screen and their looking patterns determined when the trials ended (i.e., after 2s looking away). Research assistants coded the infants live from an adjacent observation room using the Habit2 program. Infants were also video-recorded for offline reliability coding.

Infants were seated either in a highchair or on their caregiver's lap approximately 60-70cm from a large TV screen. If the infants were seated on their caregivers' laps ($n = 4$), caregivers were given sound attenuating headphones playing masking music¹ as to keep the parent unaware of the recordings that the infant was hearing at any given time. Infants received two warm-up trials (21s in duration each) to familiarize them with the general procedure. The warm-up trials comprised piano music paired with the visual checkerboard stimulus, but no centering stimulus. Once this warm-up period ended, and the preference procedure began, infants were first shown a centering stimulus that served as both the attention getter and the experimental prime. Infants were randomly assigned to either the social or nonsocial prime condition ($n=10$ in each condition). The prime played for at least 4s to allow infants access to the full audio and visual sequence, and stayed on the screen until the infant oriented and fixated on the centering event for 2s. After meeting this fixation criterion, the centering event was

¹ The masking music comprises a custom blend of instrumental music and randomly timed stimulus materials created for the Many Babies project (Bergelson et al., 2017)

terminated and followed by a multicolor checkerboard concomitant with the presentation of one of the audio tracks. The checkerboard+speech event ended when the infant looked away for 2s, or the audio event ended (21s), whichever came first. To signal the start of a new trial, the prime stimulus reappeared for at least 4s. The trials continued on in this fashion. Infants were presented with two blocks, each containing one set of four IDS tracks and one set of four ADS tracks (for a total of 16 trials). These tracks were presented in an alternating order (e.g., IDS/ADS/IDS/ADS) and the presentation order was counterbalanced across blocks. The entire experimental sequence could last a maximum of 442 seconds, or 7.4 minutes. The infant's participation ended upon the completion of the two blocks, or if the infant grew fussy or refused to sit in the highchair or on the parent's lap.

After the infant completed the behavioral preference protocol, the infant and caregiver were escorted back to the waiting room. The research assistant entertained the infant while the caregiver completed the demographic form (Appendix A), and parent-report measures on language (Appendix B; MCDI), temperament (Appendix C; IBQ), and an Autism Spectrum Disorder screener (Appendix D; MCHAT-R).

The caregiver was then provided with a "baby scientist" certificate for the infant and compensated \$20 for their participation, regardless of the infant's ability to complete the task.

Results

The primary dependent variable of interest was the average looking time during IDS compared to ADS trials as a function of the prime (attention getter) that the infant viewed before each trial. A 2 (speech type: ADS, IDS) x 2 (prime: social, nonsocial) mixed factors analysis of variance (ANOVA) revealed a significant main effect of speech type, $F(1,18) = 26.06, p < .001, \eta_p^2 = .59$, with infants demonstrating significantly longer attention on IDS ($M = 8.69$ s, $SD =$

2.80 s) compared to ADS ($M = 5.99$ s, $SD = 2.37$ s) trials. However, contrary to the prediction, there was no significant main effect of prime, $F(1,18) = .012, p < 1.0, \eta_p = .001$, and no significant interaction between speech type and prime, $F(1,18) = .025, p > .9, \eta_p = .001$ (see Figure 1). To see if there was any indication of a priming effect early in the session, the first IDS and ADS trial from each infant were compared across these conditions. One-way ANOVAs with prime as the factor and first IDS and first ADS trials as the dependent variables revealed no significant effect of prime, IDS: $F(1,4) = .01, p < 1.0$; ADS: $F(1,4) = .91, p < .40$.

Given that the only significant finding in the analysis above was for speech type, I also explored the strength of the preference for IDS v. ADS over the course of the session. As noted above, infants looked significantly longer during IDS than ADS speech trials. Moreover 18/20 infants demonstrated an IDS preference overall (binomial $p < .001$). To see how this preference looked over trials, block (first eight trials, second eight trials) was introduced as a variable in a mixed ANOVA: 2 (speech type: ADS, IDS) x 2 (block: first 8 trials, second 8 trials). Results revealed a significant main effect of block, $F(1,18) = 16.49, p < .001, \eta_p = .47$, as well as a significant interaction effect between speech type and block, $F(1,18) = 12.35, p < .003, \eta_p = .39$ (see Figure 2). Regarding the main effect of block, infants looked significantly longer during the first block than the second block. ($M_{\text{block1}} = 8.44$ s, $SD_{\text{block1}} = 3.21$ s; $M_{\text{block2}} = 6.26$ s, $SD_{\text{block2}} = 2.63$ s). In terms of the speech type x block interaction, paired sample t-tests indicated that infants looked significantly longer on IDS than ADS trials during each block, (block 1: $t(19) = 5.85, p < .001$, block 2: $t(19) = 2.98, p < .009$, $M_{\text{IDSblock1}} = 10.32$ s, $SD_{\text{IDSblock1}} = 3.34$ s, $M_{\text{ADSblock1}} = 6.55$ s, $SD_{\text{ADSblock1}} = 3.08$ s; $M_{\text{IDSblock2}} = 7.07$ s, $SD_{\text{IDSblock2}} = 2.91$ s, $M_{\text{ADSblock2}} = 5.44$ s, $SD_{\text{ADSblock2}} = 2.34$ s). In comparing attention across blocks, infants listened to IDS significantly longer in block 1 relative to block 2, $t(1,19) = 5.20, p < .001$. In contrast, infants' attention to ADS was not

significantly different across block 1 and block 2, $t(1,19) = 1.83, p < .09$. Within the first block, 19/20 infants demonstrated an IDS preference (binomial $p < .0001$), and within the second block, 15/20 demonstrated an IDS preference (binomial $p < .02$).

Lastly, the final sample of infants extended across ages that ranged from 12 to 18 months, raising the possibility that the IDS preference varied as a function of age. To examine difference in IDS preference strength over age, a ratio was calculated by the following: Average IDS/(Average IDS+Average ADS) (this ratio can range from 0 to 1.0, with .50 indicating no preference). Interestingly, there was a statistically significant, positive correlation between age and IDS preference ratio, $r = .46, p < .04$. To explore this age effect further, two age groups were created by determining the median age across all participants. This median was 14 months ($n=8$) so 4 infants with an age of 14 months were randomly assigned to a 12 - 14 month group ($n=10$) and the other 4 infants were randomly assigned to a 14 - 18 month group ($n=10$). Next, a 2 (speech type: IDS, ADS) x 2 (age group: 12-14, 14-18) mixed ANOVA was conducted. As before, the main effect of speech was statistically significant, $F(1, 18) = 31.49, p < .001, \eta_p^2 = .64$. However, the main effect of age was not significant, $F(1,18) = 2.94, p < .11, \eta_p^2 = .14$. Additionally, the speech type x age group interaction was not significant, $F(1,18) = 3.78, p < .07, \eta_p^2 = .17^2$. Nonetheless, given the significant positive correlation between age and IDS preference ratio, I conducted preliminary within age group contrasts to see if the IDS preference was different for younger v. older infants. In the younger group, infants showed a significant preference for IDS over ADS overall, $t(9) = 2.36, p < .05$, and also during block 1, $t(9) = 3.18, p < .02$, but not in the second block, $t(9) = .88, p < .41$. Like the younger infants, older infants also

² This analysis was run two more additional ways: (1) assigning the infants at the median age to the opposite group, and (2) creating three (instead of two) age groups as 12-13 months, 14 months, and 15-18 months. The ANOVA was conducted again, but the interaction between speech type x age group was not statistically significant in either case.

showed a significant preference for IDS over ADS overall, $t(9) = 6.02, p < .001$, but in contrast, showed this preference in both blocks (block 1, $t(9) = 5.37, p < .001$, and block 2, $t(9) = 4.03, p < .01$). Thus, the younger infants' preferences were diminished during the second block, whereas the older infants' IDS preferences remained in tact through the session.

In addition to the analyses of the primary hypotheses presented above, bivariate correlations were conducted to investigate ancillary hypotheses predicting relationships between temperament, expressive vocabulary, MCHAT score, and IDS preference. In regards to correlations with the IDS preference ratio, only one significant correlation emerged: a significant positive correlation between age and IDS preference, $r = .46, p < .04$. Other demographic variables and other measured variables such as autism phenotype or vocabulary were not significantly related to IDS preference. In terms of autism phenotype, a significant negative correlation between age and Autism phenotype (M-CHAT score), $r = -.59, p < .01$ was the only significant correlation. No other variables were significantly related to M-CHAT scores. In terms of vocabulary, a significant positive correlation between age and expressive vocabulary (MCDI expressive score), $r = .50, p < .025$, emerged. No other relationships with expressive scores were significant, and no variables demonstrated a significant relationship with receptive vocabulary. Lastly, no significant relationships were evidenced between variables related to temperament (surgency, negative affect, and effortful control).

Discussion

It was hypothesized that presenting infants with a social prime would increase their preference for IDS over ADS speech relative to when primed with a nonsocial stimulus. The results did show that infants significantly attended more to IDS compared to ADS, although this seemed to be a slightly stronger preference in the older infants. However, contrary to the main

prediction, no effect of prime on infants' speech preferences was seen. Thus, the expectation that seeing and hearing a female speaker in typical ID fashion would augment infants' preferences for IDS over ADS was not seen under these experimental conditions.

Although the main hypothesis of social priming was not supported, these results still demonstrated a main effect of speech type, which indicated a preference for IDS over ADS. These results extend the previous literature regarding the course of preference for IDS across the first year of infancy. Previously, the bulk of studies have found IDS preferences in younger compared to older infants, with the magnitude of IDS preference as a function of age has yielded conflicting results after the first post-natal year of life. For example, Newman and Hussain (2006) found that while the 4.5-month-olds included in their sample demonstrated an IDS preference, the 13-month-olds listened to ADS and IDS equally, thus not demonstrating the same preference as the younger infants. Conversely, a longitudinal study conducted in Japan investigated the IDS preference as a function of age and noted an inverse-U function, with younger infants (<7mos) and older infants (>10mos) demonstrating an IDS preference, but infants between 7-10mos did not (Hayashi et al., 2001). Our results suggest a strong IDS preference at mean age of 14.5 mos and thus support Hayashi et al.'s (2001) findings. The current results are also consistent with a meta-analysis by Dunst, Gorman and Hamby (2012) who found that the effect sizes for IDS preference increased gradually with age across 34 published studies.

Furthermore, the current study is one of the only to investigate IDS preference in infants as old as 18 months. The comparisons of IDS preference by age group (12-14mos, 14-18mos) demonstrated that the older infants maintained their IDS preference for the duration of the experiment (16 trials), whereas the younger infants' IDS preference only lasted throughout the

first 8 trials (block 1). These findings are in opposition to what was expected, as younger infants reportedly demonstrate a stronger IDS preference than older infants. The results may further call into question the mechanism of the IDS preference, as referenced in Hayashi et al.'s (2001) work. It may be the case that younger infants attend to IDS more than ADS due to the emotionality inherent in IDS, thus their preference decreases more rapidly than older infants', who are attending due to the structural components (the actual lexical richness of diverse utterances) driving language learning. Future studies could investigate IDS and ADS trials in foreign languages with older and younger samples to test the differential mechanism hypothesis further.

Taken together, this study provides novel information on the IDS preference in older infants, and also demonstrates that the number of total trials may attenuate younger infants' attention spans and tolerance of speech listening. The finding of an IDS preference later in infancy supports the notion that the IDS preference remains intact after the 10-month mark and may serve linguistic and cognitive utility beyond the first postnatal year.

While the speech preference for IDS was robust in this study, no significant interaction emerged between prime and speech type, indicating no evidence of priming in this experimental study. There are two potential reasons why no priming effect was evident in this study: (1) the way the priming effects were measured was not sensitive enough, or (2) some factors about the task made the social prime unsuccessful.

In terms of being able to quantify a priming effect if one was present, Wilcox et al. (2013) suggest that behavioral measures alone may be insufficient. As discussed in the introduction, Wilcox et al. investigated two conditions of priming: priming for color (e.g., green cups pound, red cups scoop), and priming for shape (e.g., round cups pound, straight cups

scoop), using fNIRS and behavioral measures (looking time). The authors reported a priming effect both behaviorally and neurally as represented by longer fixation duration and greater cerebral activation for one condition, but only neural evidence for priming in the second condition. The conclusions from the authors were that if behavioral measures were to be used in isolation, they would have only detected priming in one condition, not both, in turn, affecting their overall conclusions. So it is possible that the infant-controlled looking time measure from the current study was not sensitive enough to pick up the effects of the social prime on attention. By using measures of physiological arousal (e.g., heart rate), and/or neurophysiology (e.g., cerebral activation), priming effects may be detectable in another system. Previous papers have relied on fNIRS as a measure of cerebral activation (e.g., Wilcox et al., 2013; 2014). In addition to fNIRS, measures of heart rate could also be obtained to investigate the effects of priming at a physiological level, as prior work has extensively reported on changes in heart rate as a proxy for sustained attention (Richards, 1987). If using heart rate as a metric for sustained attention in a priming task, I would predict greater attention, as indexed by lower heart rate, when infants were receiving IDS primed by the social prime compared to IDS primed by the non-social prime. In spite of clear advantages when both neurological and behavioral measures are collected, as suggested by Wilcox et al., 2013, several previous works (e.g., Bortfeld et al., 2005, Wilcox & Chapa, 2003) have relied on behavioral measures alone to identify an effect of priming in infancy. Thus the effects of the social prime *should* be have been detectable by measuring behavior alone. Nonetheless, it would be interesting for future research to employ convergent measures (e.g., behavioral and physiological measures) to detect the effect of priming.

In another vein, the lack of effect of social prime on preference strength may be more related to the information being preferred rather than the measurement. First, the IDS-ADS

preference task has demonstrated its robust effects throughout the literature (see Vouloumanos & Curtin, 2014). Is it possible that the speech preference was *too* robust to allow for a priming effect to be detected? According to one metric (i.e., preference ratios), little variability in the IDS preference was obtained across infants, as 18 out of the 20 total demonstrated ratios above .50. On the other hand, these ratios ranged from .50 to .75. Although the sample age was chosen in hopes of gaining more variability (i.e., older infants reportedly demonstrate a smaller, or non-preference, for IDS; Newman & Hussain, 2006), the results were still robust, with an average IDS preference effect size of .59.

Future research could introduce manipulations that may be more conducive to priming effects. For example, future studies could investigate priming language preference in foreign language listening tasks, in which a nonnative IDS preference may not be as robust as a native language IDS preference, thus allowing for greater preferential variability to take place. Previous work by Kuhl et al., (2007) would suggest that infants between 12- to 18-months of age are “committing” to their native language and therefore should demonstrate a preference for listening to native IDS over nonnative IDS. This hypothesis is echoed by Hayashi et al., (2001) who argued that as infants increase in age, the mechanism that drives the IDS preference is increasingly related to language and word learning, and less about the emotion within IDS. Thus, per Hayashi’s hypotheses, if presented with native and nonnative IDS, older infants should listen more to native IDS, as their desire to learn language would drive a preference for their native language over the emotional information in the nonnative presentation. Nonnative IDS could, therefore, serve as an interesting future platform on which to investigate the effects of social priming.

Additionally, convergent methodologies could be employed to measure behavioral and neurophysiological evidence of priming. As mentioned above, the effects of prestimulation on subsequent attention in task is sometimes subtle (e.g., deceleration in heart rate) that may not always translate into measureable behavior. Employing concurrent behavioral and psychophysiological methods could help to more fully explore priming effects with infants and young children - populations in which behavioral control can often be quite challenging. Lastly, variability in task performance should be a primary focus for future studies aiming to replicate or extend this current work.

Limitations of the current study

Two limitations regarding this study should be noted: (1) the homogeneity of the sample, and (2) the age-related findings. First, the sample was homogenous in terms of demographic factors. The sample included in this study was similar in terms of socio-economic status (SES), race, parental education, and developmental status of the infants. Most of the infants and families who participated in this project were recruited through university listservs and other university-sponsored pages, which resulted in a mostly Caucasian (N = 18), well-educated group of parents (given our geographical location), as well as low levels of developmental, medical, and/or cognitive complications in the infants (via parental report). Thus, future studies could encourage greater sample diversity, including racial/ethnic diversity, socioeconomic status variability, and educational variability. By encouraging demographic variability, evidence of social priming may emerge in some samples, and not others, thus providing greater data on priming mechanisms in infancy. Additionally, the reported IDS preference in older infancy may also vary as a function of demographic factors, including but not limited to maternal psychopathology (e.g., depression), developmental status of the infant (e.g., Autism Spectrum Disorder risk), and medical

complications (e.g., premature infants). Thus, recruiting a diverse infant sample will contribute to the generalizability and greater understanding of the IDS preference and priming mechanisms.

Second, the reported differences in IDS preference between older and younger infants should be interpreted with caution. The current study investigated a wide age range (12 to 18 months), but did not have adequate sample sizes to create age groups or to investigate IDS preference in age bins. Although older infants may demonstrate a stronger IDS preference than younger infants, those conclusions cannot firmly be made from the current study.

References

- Bergelson, E., Bergmann, C., Byers-Heinlein, K., Cristia, A., Cusack, R., Dyck, K., ... Yurovsky, D. (2017). Quantifying sources of variability in infancy research using the infant-directed speech preference. Retrieved from [osf.io/preprints/psyarciv.s98ab](https://osf.io/preprints/psyarciv/s98ab)
- Blaxton, T. (1989). Investigating dissociation among memory measures: Support for a transfer appropriate processing framework. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*, 657-668.
- Bortfeld, H., Morgan, J.L., Golinkoff, R., & Rathbun, K. (2005). Mommy and me: Familiar names help launch babies into speech-stream segmentation. *Psychological Science*, *16*, 298-304. doi: 10.1111/j.0956-7976.2005.01531.x
- Brower, T.R., & Wilcox, T. (2013). Priming infants to use color in an individuation task: Does social context matter? *Infant Behavior and Development*, *36*, 349-358. doi: 10.1016/j.infbeh.2013.02.005
- Casey, B. J., & Richards, J. E. (1988). Sustained visual attention measured with an adapted version of the visual preference paradigm. *Child Development*, *59*, 1514-1521.
- Cave, B.C. (1997). Very long-lasting priming in picture naming. *Psychological Science*, *8*, 322-325.
- Christia, A. (2013). Input to language: The phonetics and perception of infant-directed speech. *Language and Linguistics Compass*, *7*, 157-170. doi: 10.1111/lnc3.12015
- Colombo, J., & Mitchell, D. W. (1990). Individual differences in early visual attention: Fixation time and cognitive processing. In J. Colombo & J. Fagen (Eds.), *Individual differences in infancy* (pp. 193-228). Hillsdale, NJ: Erlbaum.

- Colombo, J., Mitchell, D.W., Coldren, J.T., & Freesean, L.J. (1991). Individual differences in infant visual attention: Are short lookers faster processors or feature processors? *Child Development, 62*, 1247-1257.
- Colombo, J., & Salley, B. (2015). Biopsychosocial perspectives on the development of attention in infancy. In S.D. Calkins (Ed.), *Handbook of Infant Biopsychosocial Development* (pp. 71-96). New York, NY: Guilford Press.
- Cooper, R.P., & Aslin, R.N. (1990). Preference for infant-directed speech in the first month after birth. *Child Development, 61*, 1584-1595.
- Cooper, R.P., Abraham, R., Berman, S., & Staska, M. (1997). The development of infants' preference for motherese. *Infant Behavior and Development, 20*, 477-488.
- Dale, P.S., Bates, E., Reznick, J.S., & Morriset, C. (1989). The validity of a parent report instrument of child language at 20 months. *Journal of Child Language, 16*, 239-249.
- Domsch, H., Thomas, H., & Lohaus, A. (2010). Infant attention, heart rate, and looking time during habituation/dishabituation. *Infant Behavior and Development, 33*, 321-329. doi: 10.1016/j.infbeh.2010.03.008
- Droucker, D., Curtin, S., & Vouloumanos, A. (2013). Linking infant-directed speech and face preferences to language outcomes in infants at risk for autism spectrum disorder. *Journal of Speech, Language, and Hearing Research, 56*, 567-576. doi: 10.1044/1092-4388(2012/11-0266)
- Dunst, C. J., Gorman, E., & Hamby, D. W. (2012). Preference for infant-directed speech in preverbal young children. *CELL Reviews, 5*, 1-13.

- Fernald, A., Taeschner, T., Dunn, J., Papousek, M., de Boysson-Bardies, B., & Fukui, I. (1989). A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants. *Journal of Child Language*, *16*, 477-501.
- Frank, M.C., Bergelson, E., Bergmann, C., Cristia, A., Floccia, C., Gervain, J., ... & Yurovksy, D. (2017). A collaborative approach to infant research: Promoting reproducibility, best practices, and theory building. *Infancy*, 1-15. doi: 10.1111/infa.12182
- Frick, J.E., Colombo, J., & Saxon, T.F. (1999). Individual and developmental differences in disengagement of fixation in early infancy. *Child Development*, *70*, 537-548.
- Gartstein, M.A., & Rothbart, M.K. (2003). Studying infant temperament via the revised infant behavior questionnaire. *Infant Behavior and Development*, *26*, 64-86.
- Hayashi, A., Tamekawa, Y., & Kiritani, S. (2001). Developmental change in auditory preference for speech stimuli in Japanese infants. *Journal of Speech and Hearing Disorders*, *44*, 1189-1200.
- Henson, R.N.A., & Rugg, M.D. (2003). Neural response suppression, haemodynamic repetition effects, and behavioural priming. *Neuropsychologia*, *41*, 263-270.
- Johnson, M.H. (2010). Understanding the social world: A developmental neuroscience approach. In S.D. Calkins & M.A. Bell (Eds.), *Child development at the intersection of emotion and cognition: Human brain development* (pp. 153-174). Washington, DC: American Psychological Association.
- Johnson, E. K., & Zamuner, T. S. (2010). Using infant and toddler testing methods in language acquisition research. In E. Blom & S. Unsworth (Eds.), *Experimental methods in language acquisition research* (pp. 73–94). Amsterdam: John Benjamins.

- Kihlstrom, J.F., & Schachter, D.L. (1990). Anesthesia, amnesia, and the cognitive unconscious. In *Memory and Awareness in Anesthesia*. Edited by Bonke B., Fitch W., Millar K. Amsterdam: Swets & Zeitlinger; 21-44.
- Kitamura, C., & Lam, C. (2009). Age-specific preferences for infant-directed affective intent. *Infancy, 14*, 77-100.
- Kuhl, P.K., Tsao, F.-M., & Liu, H.-M. (2003). Foreign-language experience in infancy: Effects of short-term exposure and social interaction on phonetic learning. *Proceedings of the National Academy of Sciences, 100*, 9096–9101.
- Kuhl, P.K. (2007). Is speech learning ‘gated’ by the social brain? *Developmental Science, 10*, 110-120. doi: 10.1111/j.1467-7687.2007.00572.x
- Kuhl, P.K., Coffey-Corina, S., Padden, D., & Dawson, G. (2004). Links between social and linguistic processing of speech in preschool children with autism: Behavioral and electrophysiological measures. *Developmental Science, 8*, F1-F12. doi:10.1111/j.1467-7678-.2004.00384.x
- Lansink, J.M., & Richards, J.E. (1997). Heart rate and behavioral measures of attention in six-, nine-, and twelve-month-old infants during object exploration. *Child Development, 68*, 610-620.
- Lewis, M. L., Braginsky, M., Tsuji, S., Bergmann, C., Piccinini, P., Cristia, A., Frank, M. C. (2016). A quantitative synthesis of early language acquisition using meta-analysis. Preprint retrieved from <https://osf.io/htsjm/>.
- McRoberts, G., McDonough, C., & Lakusta, L. (2009). The role of verbal repetition in the development of infant speech preferences from 4 to 14 months of age. *Infancy, 14*, 162-194. doi: 10.1080/15250000802707062

- Miller, J.F., Sedey, A.L., & Miolo, G. (1995). Validity of parent report measures of vocabulary development for children with Down's syndrome. *Journal of Speech and Hearing Research, 38*, 1037-1044.
- Newman, R.S., & Hussain, I. (2006). Changes in preference for infant-directed speech in low and moderate noise by 4.5- to 13-month olds. *Infancy, 10*, 61-76.
doi:10.1207/s15327078in1001_4
- Over, H., & Carpenter, M. (2009). Eighteen-month-old infants show increased helping following priming with affiliation. *Psychological Science, 20*, 1189-1193.
- Peter, V., Kalashnikova, M., Santos, A., & Burnham, D. (2016). Mature neural responses to infant-directed speech but not adult-directed speech in pre-verbal infants. *Scientific Reports, 6*, 1-13. doi: 10.1038/srep34273
- Prakash, R. S., DeLeon, A., Mourany, L., Lee, H., Voss, M., Boot, W., Basak, C, Fabiani, M., Gratton, G., & Kramer, A. (2012). Examining neural correlates of skill acquisition in a complex videogame training program. *Frontiers in Human Neuroscience, 6*, 1-11.
doi:10.3389/fnhum.2012.00115
- Putnam, S.P., Helbig, A.L., Gartstein, M.A., Rothbart, M.K., & Leerkes, E. (2014). Development and assessment of short and very short forms of the infant behavior questionnaire-revised. *Journal of Personality Assessment, 1-14*. doi: 10.1080/00223891.2013.841171
- Ramirez-Esparza, N., Garcia-Sieer, A., Kuhl, P.K. (2014). Look who's talking: speech style and social context in language input to infants are linked to concurrent and future speech development. *Developmental Science, 17*, 880-891. doi: 10.1111/desc.12172
- Richards, J. E. (1987). Infant visual sustained attention and respiratory sinus arrhythmia. *Child Development, 58*, 488-496.

- Robins, D.L., Casagrande, K., Barton, M., Chen, C.A., Dumont-Mathieu, T., & Fein, D. (2013). Validation of the modified checklist for autism in toddlers, revised with follow-up (MCHAT-R-F). *Pediatrics*, *133*, 37-45. doi: 10.1542.peds.2013-1813.
- Salley, B., & Colombo, J. (2016). Conceptualizing social attention in developmental research. *Social Development*, *25*, 687-703. doi: 10.1111/sode.12174
- Santesso, D.L., Schmidt, L.A., & Trainor, L.J. (2007). Frontal brain electrical activity (EEG) and heart rate in response to affective infant-directed (ID) speech in 9-month-old infants. *Brain and Cognition*, *65*, 14-21. doi: 10.1016/j.bandc.2007.02.08
- Segal, J., & Newman, R.S. (2015). Infant preferences for structural and prosodic properties of infant-directed speech in the second year of life. *Infancy*, *20*, 339-351. doi: 10.1111/infa.12077
- Senju, A., & Csibra, G. (2008). Gaze following in human infants depends on communicative signals. *Current Topics in Biology*, *18*, 668-671. doi: 10.1016/j.cub.2008.03.059
- Schacter, D.L., & Buckner, R.L. (1998). Priming and the brain. *Neuron*, *20*, 185-95.
- Schacter, D.L., Harbluk, J.L., & McLachlan, D.R. (1984). Retrieval without recollection: An experimental analysis of source amnesia. *Journal of Verbal Learning and Verbal Behavior*, *23*, 593-611.
- Thal, D.J., Desjardin, J.L., & Eisenberg, L.S. (2007). Validity of the MacArthur-Bates Communicative Development Inventories for measuring language abilities in children with cochlear implants. *American Journal of Speech Language Pathology*, *16*, 54-54.
- Thal, D.J., O'Hanlon, L., Clemmons, M., & Fralin, L. (1999). Validity of a parent report measure of vocabulary and syntax for preschool children with language impairment. *Journal of Speech, Language, and Hearing Research*, *42*, 482-496.

- Thiessen, E.D., Hill, E.A., & Saffran, J.R. (2005). Infant-directed speech facilitates word segmentation. *Infancy*, 7, 53-71.
- Tulving, E., & Schacter, D. L. (1990). Priming and human memory systems. *Science*, 247, 301-306.
- Vouloumanos, A., & Curtin, S. (2014). Foundational tuning: How infants' attention to speech predicts language development. *Cognitive Science*, 38, 1675-1686. doi: 10.1111/cogs.12128
- Wang, S. (2011). Priming 4.5-month-old infants to use height information by enhancing retrieval. *Developmental Psychology*, 11, 26-38. doi: 10.1037/a0021060
- Werker, J. F., & McLeod, P. J. (1989). Infant preference for both male and female infant-directed talk: a developmental study of attentional and affective responsiveness. *Canadian Journal of Psychology/Revue Canadienne de Psychologie*, 43(2), 230.
- Wilcox, T., & Chapa, C. (2003). Priming infants to attend to color and pattern information in an individuation task. *Cognition*, 90, 265-302. doi: 10.1016/S0010-0277(03)00147-1
- Wilcox, T., Hirshkowitz, A., Hawkins, L., & Boas, D.A. (2014). The effect of color priming on infant brain and behavior. *NeuroImage*, 85, 302-313. doi: 10.1016/j.neuroimage.2013.08.045

Tables

Table 1. Participant demographics.

	Age (months)		Females
	<i>Mean</i>	<i>SD</i>	
Nonsocial	14.2	1.5	6
Social	14.8	1.8	7

Figures

Figure 1. Speech type by prime interaction with standard error bars.

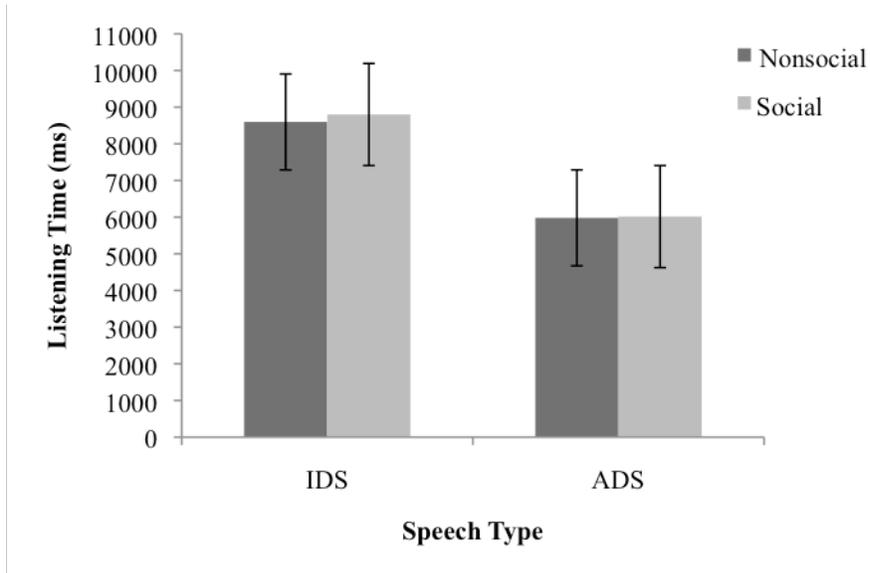
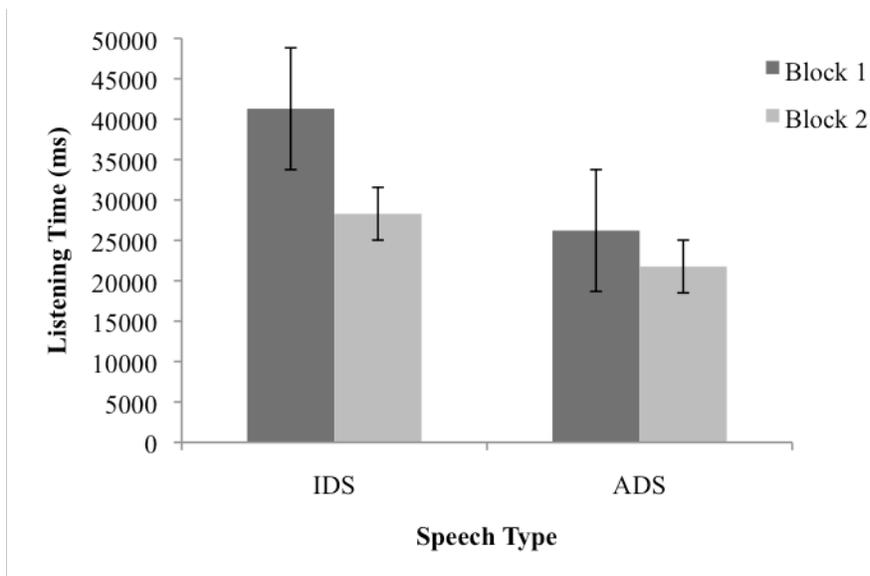


Figure 2. Block by speech type interaction with standard error bars.



Appendix A: Demographic Questionnaire

Infant – Language Emotion Attention Perception Laboratory Confidential Family Information Survey

INFANT INFORMATION

Infant's Birth Month & Year: _____ Sex: M F Birth Weight: _____ lbs
_____ ozs

Was your infant: Full Term (38-42 weeks) Premature (\leq 37 weeks) Postmature ($>$ 42 weeks)

Has the infant ever been diagnosed with a middle ear infection? Yes No How many? _____

Has your infant had any other medical/developmental problems? Yes No

If yes, please describe:

What is the primary language spoken to the infant in your home? _____

Please list any other languages that are spoken to the infant in your home: _____

FAMILY INFORMATION

Mother's Current Age: _____ Father's Current 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 Cohabiting Single Widowed

Mother's Race: White Asian American Indian/Alaska Native Native Hawaiian/Pacific Islander
Hispanic/Latino Black/African American

Father's Race: White Asian American Indian/Alaska Native Native Hawaiian/Pacific Islander
Hispanic/Latino Black/African American

Are there older children living in your home? Yes No If yes, please list their ages: _____

Has any child in the family been diagnosed/suspected of hearing impairment? Yes No

If yes, please describe: _____

Has any child in the family been diagnosed/suspected of language impairment? Yes No

If yes, please describe: _____

Has any child in the family been diagnosed/suspected of an autism spectrum disorder? Yes No

If yes, please describe: _____

Appendix B: Consent

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

Title: Social and Nonsocial Priming Effects on 12- to 15-Month-Olds' Preferences for Infant-Directed Speech

Principal Investigator(s): Dr. Robin Panneton, Associate Professor, & Tyler McFayden, Graduate Student

Purpose of this Research/Project: The purpose of this project is to investigate 12-15-month-olds attention and preference to different types of speech. Infants will be presented with Infant-Directed Speech (IDS), or speech from a female voice directed towards an infant, and Adult-Directed Speech (ADS), which is a female speaking to another adult. We will be audio and video-recording your infant's looking patterns when each of these speech events are presented. Your participation in this study benefits the study of perception speech and language development and acquisition.

Procedures: Your child will be tested for approximately twenty minutes. Your child will have the option to either sit in a high chair, or on your lap. Your child will view either a moving spiral with music, or a video of a female saying hello to your infant to capture attention. Once looking at the screen, they will see a multi-color checkerboard and hear either IDS or ADS. The procedure is infant-controlled, meaning your infant's looking will determine how long the speech and checkerboard play. Your infant will hear and see four blocks of 2 IDS and 2 ADS trials, for a total of 16 events. The loudness of the audio tracks being played to your child is no more than that heard by infants in their typical home environment (@ 68dB SPL). Each infant will be videotaped during his/her session for subsequent coding offline. If for any reason your child cries, grows fussy, or falls asleep, testing will be discontinued.

Risks: There are no apparent risks to your child or to yourself for participation in this study. Sound levels for all auditory stimuli will be verified prior to the testing of each subject.

Benefits: There are no direct benefits to the participants of this study. Parents will receive a certificate of appreciation and the results of the study will contribute to a broader body of research on infant attention and perception.

Extent of Anonymity and Confidentiality: All of the information gathered in this study will be kept confidential. The information gathered in this study will be de-identified and shared to a larger research database as a part of this project. 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. Any results that will be presented will be de-identified. You will be sent a summary of the work when this project is completed.

Compensation: Parents will be compensated \$20 for their child's participation in this study.

Freedom to Withdraw: You have the right to terminate your child’s involvement at any point in time and for any reason should you choose to do so. Your compensation will not be affected should you choose to terminate your involvement.

Subject’s Responsibilities: I voluntarily agree to have my child participate in this study.

Subject’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. This project has been approved by the Human Subjects Committee of the Department of Psychology and the Institutional Review Board of Virginia Tech. 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 and her co-workers to test my son/daughter.

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

Signature of parent: _____

Date: _____

Child’s Name: _____

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

Appendix C: MCDI

MacArthur-Bates Short Form Vocabulary Checklist: Level I

Copyright 1993 All Rights Reserved*
*For information or copies please contact the
Cognitive Development Laboratory at San Diego State University
at (619) 594-6634 or www.sciencem.sdsu.edu/cdl/

Please circle who filled out this form:
 mother father
 other (specify relation to child) _____

Child's Name _____ Sex _____
 _____ Today's Date _____

VOCABULARY CHECKLIST

For words your child understands but does not yet say, mark the first column (understands). For words that your child not only understands but also says, mark the second column (understands and says). If your child uses a different pronunciation of a word, mark it anyway.

	Understands	Understands and says		Understands	Understands and says		Understands	Understands and says
choo choo	0	0	chair	0	0	wait	0	0
meow	0	0	couch	0	0	break	0	0
ouch	0	0	kitchen	0	0	feed	0	0
uh oh	0	0	table	0	0	finish	0	0
bird	0	0	television	0	0	help	0	0
dog	0	0	blanket	0	0	jump	0	0
duck	0	0	bottle	0	0	kick	0	0
kitty	0	0	cup	0	0	kiss	0	0
lion	0	0	dish	0	0	push	0	0
mouse	0	0	lamp	0	0	sing	0	0
car	0	0	radio	0	0	smile	0	0
stroller	0	0	spoon	0	0	night	0	0
ball	0	0	flower	0	0	today	0	0
book	0	0	home	0	0	all gone	0	0
doll	0	0	moon	0	0	big	0	0
bread	0	0	outside	0	0	broken	0	0
candy	0	0	plant	0	0	dark	0	0
cereal	0	0	rain	0	0	fast	0	0
cookie	0	0	rock	0	0	hurt	0	0
juice	0	0	water	0	0	pretty	0	0
toast	0	0	babysitter	0	0	soft	0	0
hat	0	0	girl	0	0	I	0	0
pants	0	0	grandma	0	0	me	0	0
shoe	0	0	mommy	0	0	how	0	0
sock	0	0	bath	0	0	who	0	0
eye	0	0	don't	0	0	away	0	0
head	0	0	hi	0	0	out	0	0
leg	0	0	night night	0	0	other	0	0
nose	0	0	patty cake	0	0	some	0	0
tooth	0	0	please	0	0		0	0

Appendix D: IBQ

© 2000
 Mary K. Rothbart
 Maria A. Gartstein
 All Rights Reserved

Infant Behavior Questionnaire – Revised Very Short Form

Subject No. _____ Date of Baby's Birth _____ month. _____ day
 year
 Today's Date _____ Age of Child _____ mos. _____ weeks
 Sex of Child _____

INSTRUCTIONS:

Please read carefully before starting:

As you read each description of your baby's behavior below, please indicate how often your baby did this during the time period specified in each question by circling one of the numbers. These numbers indicate how often you observed the behavior described during the given time interval, or when no time interval is specified, how often you observe the behavior in general.

1	2	3	4	5	6	7	NA
Never	Very Rarely	Less Than Half the Time	About Half the Time	More Than Half the Time	Almost Always	Always	Does Not Apply

The "Does Not Apply" (NA) column is used when you did not see your baby in the situation described during the time interval specified. For example, if the situation mentions your baby having to wait for food or liquids and there was no time during that period when your baby had to wait, circle "NA". "Does Not Apply" is different from "Never" (1). "Never" is used when you saw your baby in the situation but your baby never engaged in the behavior listed during the specified time interval. For example, if your baby did have to wait for food or liquids at least once but never cried loudly while waiting, circle "1".

Please be sure to circle a number for every item.

1. When being dressed or undressed during the last week, how often did your baby squirm and/or try to roll away?

1 2 3 4 5 6 7 NA

2. When tossed around playfully how often does your baby laugh?

1 2 3 4 5 6 7 NA

3. When tired, how often during the last week did your baby show distress?

1 2 3 4 5 6 7 NA

4. When introduced to an unfamiliar adult, how often does your baby cling to a parent?

1 2 3 4 5 6 7 NA

5. How often does your baby enjoy being read to?

1 2 3 4 5 6 7 NA

6. How often during the last week did your baby play with one toy or object for 5 to 10 minutes?

1 2 3 4 5 6 7 NA

7. How often during the last week did your baby move quickly toward a new object?

1 2 3 4 5 6 7 NA

8. When put into the bath water during the last week, how often did your baby laugh?

1 2 3 4 5 6 7 NA

9. When it was time for bed or a nap and your baby did not want to go, how often did s/he whimper or sob during the last week?

1 2 3 4 5 6 7 NA

10. After sleeping during the last week, how often did your baby cry if someone didn't come within a few minutes?

1 2 3 4 5 6 7 NA

11. In the last week, while being fed in your lap, how often did your baby seem eager to get away as soon as the feeding was over?

1 2 3 4 5 6 7 NA

12. When singing or talking to your baby, how often does s/he soothe immediately?

1 2 3 4 5 6 7 NA

13. When placed on his/her back, how often does your baby squirm and/or turn body?

1 2 3 4 5 6 7 NA

14. During a peekaboo game, how often does your baby laugh?

1 2 3 4 5 6 7 NA

15. How often does your infant look up from playing when the telephone rings?

1 2 3 4 5 6 7 NA

16. How often did your baby seem angry (crying and fussing) when you left her/him in the crib during the last week?

1 2 3 4 5 6 7 NA

17. How often during the last week did your baby startle at a sudden change in body position (e.g., when moved suddenly)?

1 2 3 4 5 6 7 NA

18. How often does your baby enjoy hearing the sound of words, as in nursery rhymes?

1 2 3 4 5 6 7 NA

19. How often does your baby look at pictures in books and/or magazines for 5 minutes or longer at a time?

1 2 3 4 5 6 7 NA

20. When visiting a new place, how often does your baby get excited about exploring new surroundings?

1 2 3 4 5 6 7 NA

21. How often during the last week did your baby smile or laugh when given a toy?

1 2 3 4 5 6 7 NA

22. At the end of an exciting day, how often does your baby become tearful?

1 2 3 4 5 6 7 NA

23. How often during the last week did your baby protest being placed in a confining place (infant seat, play pen, car seat, etc.)?

1 2 3 4 5 6 7 NA

24. When being held in the last week, did your baby seem to enjoy him/herself?

1 2 3 4 5 6 7 NA

25. When showing your baby something to look at, how often does s/he soothe immediately?

1 2 3 4 5 6 7 NA

26. When hair was washed, how often does your baby vocalize?

1 2 3 4 5 6 7 NA

27. How often does your baby notice the sound of an airplane passing overhead?

1 2 3 4 5 6 7 NA

28. When introduced to an unfamiliar adult, how often does your baby refuse to go to the unfamiliar person?

1 2 3 4 5 6 7 NA

29. When you are busy with another activity, and your baby is not able to get your attention, how often does s/he cry?

1 2 3 4 5 6 7 NA

30. How often during the last week did your baby enjoy gentle rhythmic activities, such as rocking or swaying?

1 2 3 4 5 6 7 NA

31. How often during the last week did your baby stare at a mobile, crib bumper or picture for 5 minutes or longer?

1 2 3 4 5 6 7 NA

32. When your baby wants something, how often does s/he become upset when s/he can

not get what s/he wants?

1 2 3 4 5 6 7 NA

33. When in the presence of several unfamiliar adults, how often does your baby cling to a parent?

1 2 3 4 5 6 7 NA

34. When rocked or hugged, in the last week, did your baby seem to enjoy him/herself?

1 2 3 4 5 6 7 NA

35. When patting or gently rubbing some part of your baby's body during the last week, how often did s/he soothe immediately?

1 2 3 4 5 6 7 NA

36. How often does your baby make talking sounds when riding in a car?

1 2 3 4 5 6 7 NA

37. When placed in an infant seat or car seat, how often does your baby squirm and turn body?

1 2 3 4 5 6 7 NA

SCORING PROCEDURE

INFANT BEHAVIOR QUESTIONNAIRE – REVISED – VERY SHORT FORM

Scale scores for the Infant Behavior Questionnaire – Revised – Very Short Form represent the mean score of all scale items applicable to the child, as judged by the caregiver. Scales' scores are to be computed by the following method:

1. Sum all numerical item responses for a given scale. Note that:

a) If caregiver omitted an item, that item receives no numerical score;

b) If caregiver checked the "does not apply" response option for an item, that item receives no numerical score;

2. Divide the total by the number of items receiving a numerical response. Do not include items marked "does not apply (N/A)" or items receiving no response in determining the number of items.

For example, given a sum of 47 for a scale of 12 items, with one item receiving no response, two items marked "does not apply," and 9 items receiving a numerical response, the sum of 47 would be divided by 9 to yield a mean of 5.22 for the scale score.

Note: Most statistics programs will carry out these steps for you. Users of SPSS can copy the following commands into a syntax file to reverse items and calculate scale scores. The syntax assumes that items are titled "ibqrvsh1", "ibqrvsh2", "ibqrvsh3", etc. It is also assumed that no score was entered when caregivers omitted an item or checked "Does not apply".

```
COMPUTE ibqrvsh11r = (8-ibqrvsh11).
```

```
COMPUTE sur = mean (ibqrvsh1, ibqrvsh2, ibqrvsh7, ibqrvsh8, ibqrvsh13, ibqrvsh14,
ibqrvsh15, ibqrvsh20, ibqrvsh21, ibqrvsh26, ibqrvsh27, ibqrvsh36, ibqrvsh37).
```

```
COMPUTE neg = mean (ibqrvsh3, ibqrvsh4, ibqrvsh9, ibqrvsh10, ibqrvsh16, ibqrvsh17,
ibqrvsh22, ibqrvsh23, ibqrvsh28, ibqrvsh29, ibqrvsh32, ibqrvsh33).
```

```
COMPUTE eff = mean (ibqrvsh5, ibqrvsh6, ibqrvsh11r, ibqrvsh12, ibqrvsh18, ibqrvsh19,
ibqrvsh24, ibqrvsh25, ibqrvsh30, ibqrvsh31, ibqrvsh34, ibqrvsh35).
```

```
EXECUTE .
```

Infant Behavior Questionnaire – Revised – Very Short Form: Items by Scale

I. Surgency

1. When being dressed or undressed during the last week, how often did the baby squirm and/or try to roll away?
2. When tossed around playfully how often did the baby laugh?
7. How often during the week did your baby move quickly toward new objects?
8. When put into the bath water, how often did the baby laugh?
13. When placed on his/her back, how often did the baby squirm and/or turn body?
14. During a peekaboo game, how often did the baby laugh?
15. How often does the infant look up from playing when the telephone rings?
20. When visiting a new place, how often did your baby get excited about exploring new surroundings?
21. How often during the last week did the baby smile or laugh when given a toy?
26. When hair was washed, how often did the baby vocalize?
27. How often did your baby notice the sound of an airplane passing overhead?
36. How often did your baby make talking sounds when riding in a car?
37. When placed in an infant seat or car seat, how often did the baby squirm and turn body?

II. Negative Affect

3. When tired, how often did your baby show distress?
4. When introduced to an unfamiliar adult, how often did the baby cling to a parent?
9. When it was time for bed or a nap and your baby did not want to go, how often did s/he whimper or sob?
10. After sleeping, how often did the baby cry if someone doesn't come within a few minutes?
16. How often did the baby seem angry (crying and fussing) when you left her/him in the crib?
17. How often during the last week did the baby startle at a sudden change in body position (e.g., when moved suddenly)?
22. At the end of an exciting day, how often did your baby become tearful?
23. How often during the last week did the baby protest being placed in a confining place (infant seat, play pen, car seat, etc.)?
28. When introduced to an unfamiliar adult, how often did the baby refuse to go to the unfamiliar person?
29. When you were busy with another activity, and your baby was not able to get your attention, how often did s/he cry?
32. When the baby wanted something, how often did s/he become upset when s/he could not get what s/he wanted?
33. When in the presence of several unfamiliar adults, how often did the baby cling to a parent?

III. Effortful Control

5. How often during the last week did the baby enjoy being read to?
6. How often during the last week did the baby play with one toy or object for 5-10 minutes?
- 11R. In the last week, while being fed in your lap, how often did the baby seem eager to get away as soon as the feeding was over?
12. When singing or talking to your baby, how often did s/he soothe immediately?
18. How often during the last week did the baby enjoy hearing the sound of words, as in nursery rhymes?
19. How often during the last week did the baby look at pictures in books and/or magazines for 5 minutes or longer at a time?
24. When being held, in the last week, did your baby seem to enjoy him/herself?
25. When showing the baby something to look at, how often did s/he soothe immediately?
30. How often during the last week did the baby enjoy gentle rhythmic activities, such as rocking or swaying?
31. How often during the last week did the baby stare at a mobile, crib bumper or picture for 5 minutes or longer?
34. When rocked or hugged, in the last week, did your baby seem to enjoy him/herself?
35. When patting or gently rubbing some part of the baby's body, how often did s/he soothe immediately?

Appendix E: MCHAT-R

M-CHAT-R™

Please answer these questions about your child. Keep in mind how your child usually behaves. If you have seen your child do the behavior a few times, but he or she does not usually do it, then please answer **no**. Please circle **yes** or **no** for every question. Thank you very much.

1. If you point at something across the room, does your child look at it? (FOR EXAMPLE, if you point at a toy or an animal, does your child look at the toy or animal?)	Yes	No
2. Have you ever wondered if your child might be deaf?	Yes	No
3. Does your child play pretend or make-believe? (FOR EXAMPLE, pretend to drink from an empty cup, pretend to talk on a phone, or pretend to feed a doll or stuffed animal?)	Yes	No
4. Does your child like climbing on things? (FOR EXAMPLE, furniture, playground equipment, or stairs)	Yes	No
5. Does your child make <u>unusual</u> finger movements near his or her eyes? (FOR EXAMPLE, does your child wiggle his or her fingers close to his or her eyes?)	Yes	No
6. Does your child point with one finger to ask for something or to get help? (FOR EXAMPLE, pointing to a snack or toy that is out of reach)	Yes	No
7. Does your child point with one finger to show you something interesting? (FOR EXAMPLE, pointing to an airplane in the sky or a big truck in the road)	Yes	No
8. Is your child interested in other children? (FOR EXAMPLE, does your child watch other children, smile at them, or go to them?)	Yes	No
9. Does your child show you things by bringing them to you or holding them up for you to see – not to get help, but just to share? (FOR EXAMPLE, showing you a flower, a stuffed animal, or a toy truck)	Yes	No
10. Does your child respond when you call his or her name? (FOR EXAMPLE, does he or she look up, talk or babble, or stop what he or she is doing when you call his or her name?)	Yes	No
11. When you smile at your child, does he or she smile back at you?	Yes	No
12. Does your child get upset by everyday noises? (FOR EXAMPLE, does your child scream or cry to noise such as a vacuum cleaner or loud music?)	Yes	No
13. Does your child walk?	Yes	No
14. Does your child look you in the eye when you are talking to him or her, playing with him or her, or dressing him or her?	Yes	No
15. Does your child try to copy what you do? (FOR EXAMPLE, wave bye-bye, clap, or make a funny noise when you do)	Yes	No
16. If you turn your head to look at something, does your child look around to see what you are looking at?	Yes	No
17. Does your child try to get you to watch him or her? (FOR EXAMPLE, does your child look at you for praise, or say "look" or "watch me"?)	Yes	No
18. Does your child understand when you tell him or her to do something? (FOR EXAMPLE, if you don't point, can your child understand "put the book on the chair" or "bring me the blanket"?)	Yes	No
19. If something new happens, does your child look at your face to see how you feel about it? (FOR EXAMPLE, if he or she hears a strange or funny noise, or sees a new toy, will he or she look at your face?)	Yes	No
20. Does your child like movement activities? (FOR EXAMPLE, being swung or bounced on your knee)	Yes	No