

INFANTS' EXPECTATIONS ABOUT THIRD-PARTY AFFILIATIONS
BASED ON INFANT-DIRECTED SPEECH: A PUPIL-SIZE STUDY

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DECLARATION OF ORIGINALITY

I, Neslihan Oğuz, certify that

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- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
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ABSTRACT

Infants' expectations about third-party affiliations based on infant-directed speech: A pupil-size study.

Various cues are used by infants to infer others' social preferences. This thesis aims to ask whether infants use infant-directed communication to make such inferences. Three experiments, using a VoE (Violation of expectation) paradigm and eye tracking, investigating 14- to 18-month-olds' expectations about affiliative decisions based on speech registers. Experiment 1 and 2 presented infants videos where an adult character responded to a crying baby either using infant-directed speech (IDS) or adult-directed speech (ADS). In the silent test trials infant character approached the adult character who previously used IDS (congruent) or the adult character who previously used ADS. Infants showed equal looking time at congruent or incongruent events. Experiment 3 presented videos where an adult character responded to a babbling baby either using IDS or ADS to 14- to 18-month-olds. In the silent test trials infant character was seen either next to the adult character who previously used IDS (congruent) or next to the adult character who previously used ADS. Again, infants showed equal looking time at congruent or incongruent events., however they showed greater pupil dilation during incongruent events. According to these findings, infants may infer third parties' affiliative relationships from their speech registers, however, these expectations seem to be only evident in their pupil reactions and not in their looking times. These results provide insight into the different methodologies used to examine infants' third-party inference.

ÖZET

Bebeklerin, bebeklere yönelik iletişime dayalı üçüncü şahıslar arasındaki yakınlık beklentileri: Bir göz bebeği boyutu çalışması.

Bebekler, pek çok ip ucuna dayalı olarak kişilerin sosyal tercihleri hakkında beklenti oluşturmaktadır. Bu tez, bebeklerin benzer çıkarımları bebeğe yönelik konuşmaya dayalı olarak yapıp yapmadıklarını incelemektedir. Üç deneyde, 14 ila 18 aylık bebeklerin konuşma biçimlerine dayalı ilişkisel kararlarla ilgili beklentilerini araştırmak için BiP (Beklentinin ihlali paradigması) ve göz izleme kullanıldı. Deney 1 ve 2, yetişkin bir karakterin ağlayan bir bebeğe bebek yönelimli konuşma (BYK) veya yetişkin yönelimli konuşma (YYK) kullanarak yanıt verdiği videolar sundu. Sessiz test denemelerinde ise bebek karakter, daha önce BYK (uyumlu) kullanan yetişkin karaktere veya daha önce YYK kullanan yetişkin karaktere yaklaştı. Bebeklerin uyumlu ve uyumsuz olaylara eşit şekilde baktıklarını bulduk. Deney 3, 14 ila 18 aylık bebeklere yetişkin bir karakterin babıldayan bir bebeğe BYK veya YYK kullanarak yanıt verdiği videolar sundu. Sessiz test denemelerinde bebek karakter, daha önce BYK (uyumlu) kullanan yetişkin karakterin yanında veya daha önce YYK kullanan yetişkin karakterin yanında görüldü. Yine, bebekler uyumlu ve uyumsuz olaylara eşit olarak baktılar, ancak uyumsuz olaylar sırasında daha fazla gözbebeği genişlemesi gösterdiler. Bu sonuçlar, bebeklerin konuşma kaydını üçüncü şahıslar hakkında ilişkisel çıkarımlar yapmak için bir ipucu olarak kullanabileceklerini göstermektedir, ancak bu beklentiler, bakma sürelerinde değil, yalnızca öğrenci tepkilerinde belirgin görünmektedir. Bu sonuçlar, bebeklerin üçüncü taraf çıkarımlarını incelemek için kullanılan farklı metodolojiler hakkında bilgi sağlar.

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CHAPTER 1

INTRODUCTION

Human babies begin their lives relatively helpless compared to the other species (Hrdy, 2009). Therefore, they mainly depend on sources parents yield. Such resources constitute the parental investment provided to the infant on a daily basis, often in response to their fussiness or crying. Some characteristics differentiate parent-child interactions from other affiliative social interactions (Spokes & Spelke, 2017). They are asymmetrical in that parents behave in their children's best interests without anticipating or receiving equal reciprocation due to adults' more excellent knowledge, competence, and power. Secondly, the exchange between parents and children is often characterized by acts of comfort, nurturing, and help. In addition to the acts, special speech registers directed to infants may also serve caregiving by providing important information, such as the fact that an adult is present and paying attention to the baby (Mehr & Krasnow, 2017). Growing evidence indicates that infants develop expectations regarding caregiving actions. For instance, Johnson and her colleagues asked whether infants expect comforting actions from adults when interacting with a crying baby and found that when the infant was securely attached, the adult was expected to return to the crying baby instead of turning away from it (Johnson et al., 2007; Johnson et al., 2010). Yet, no study to this date examined whether infants develop an expectancy about third party affiliations based on infant-directed communication. Based on the findings of Soley and Sebastian-Galles (2020), infants expect adults to talk to them in an infant-directed manner. However, it is still unknown whether infants expect an adult who communicates

with a baby using IDS to be favored over another adult who communicates with the baby using ADS in a context where speech can serve as a caregiving action. This dissertation aims to answer this question by using eye-tracking method.

1.1 Infant-directed speech

Several studies have demonstrated that parental speech to infants is characterized by consistent patterns of prosodic alteration. According to Fernald et al. (1989), French, Italian, German, Japanese, British English, and American English all have similar speech styles directed toward preverbal infants. Similarly, Fijians, Kenyans, and North Americans speak at a higher fundamental frequency to newborns than to adults, as Broesch and Bryant (2014) reported. Adults also utilize much more fundamental frequency variation and fewer syllables per second. Compared to adult-directed speech, Fernald (1989) also found that mothers and fathers use shorter utterances, longer pauses, higher mean fundamental frequency, and higher -minimum maximum fundamental frequencies throughout their infant-directed speech. Similarly, Cox et al. (2022) found that articulation rate, vowel duration, and fundamental frequency (f_0) in IDS gradually mimic adult-directed speech, although f_0 variability and vowel space area remained stable throughout. Such differences are distinguishable for adult listeners even the spoken languages are unfamiliar to them (Bryant & Barrett, 2007; Golinkoff & Alioto, 1995). Infant-directed speech style also allows listeners to make inferences regarding age such that they can correctly guess which of the two child-directed speech segments address a younger or an older child (Bozkurt & Soley, 2022).

1.2 Infant-directed speech preference

ADS and IDS cause different reactions in infants, according to numerous research conducted in diverse cultures, using a variety of methods and including a range of age groups. For instance, according to a study by Werker and McLeod (1989), infants prefer IDS over ADS when it is given by both females and males. Similarly, Fernald (1985) has shown that infants turn their heads more towards IDS than ADS. Infants attend more to IDS starting at one-month (Cooper & Aslin, 1990) and infants exhibit increased brain activity when listening to IDS at 7 months (Zangl & Mills, 2007). Based on a cross-cultural study examining the preference for IDS of monolingual infants aged 3-15 months from different linguistic backgrounds using speech samples in North American English, infants of all cultures and ages preferred IDS over ADS, despite the fact that the speech was in a foreign language (Frank et al., 2020), this preference was distinguishable.

1.3 Functions of infant-directed speech

As a form of social learning, communication involves the transfer of skills or knowledge between two individuals (Csibra & Gergely, 2011). In order to transmit generic knowledge to novices, specific aspects of human communication, known as “natural pedagogy,” can be utilized. The intonation pattern of infant-directed speech might indicate that it is directed toward an infant as well as that the infant is intended to hear the communication (Csibra & Gergely, 2009). In line with this, infants infer that IDS is intended for infants, and ADS is intended for adults (Soley & Sebastian-Galles, 2020). Through speech modifications made while communicating with infants and young children, adults can contribute to the social and linguistic development of novices. Many acoustic (e.g., short utterances, pitch variability) and

structural (e.g., frequent questions) aspects of IDS are argued to help language development by facilitating comprehension and grabbing attention (Schick et al., 2022). Likewise, with the help of IDS prosody, infants link sounds to meanings more readily, and the variability in prosody characteristics of IDS may contribute to its effectiveness in teaching new words to infants (Estes & Hurley, 2013). Kalashnikova et al. (2018) also showed that infants' speech processing and even later language development may benefit from IDS because it facilitates cortical tracking of incoming speech.

With its exaggerated intonation and pitch, IDS can serve other purposes besides language acquisition. It may serve as a pedagogical tool and facilitate infants' learning, as well as serve multiple social functions. For instance, according to Fernald (1992), in the beginning, intonation is primarily a perceptual and tonal influence, but over time it begins to gain affective meaning and convey to the preverbal infant information about intentions such as comforting. Similarly, Golinkoff et al. (2015) proposed that because it is used in social relationships, IDS may contribute the development of positive relationships between adults and infants as well as promoting infants' abilities to analyze language. IDS may have developed to help infants and children adjust to the external world, according to Fernald (1992). It may be possible for caregivers to reflect on their emotions through the use of IDS since it is a type of speech with a positive valence (Trainor & Desjardins, 2002). Structure of the speech register may also provide an important source of information on who the appropriate social partner is. In fact, infants prefer to attend adults who previously addressed them using IDS (Schachner & Hannon, 2011).

1.4 Infants' third-party inferences

It is a well-known finding that infants use speech cues to detect appropriate social partners for themselves. Kinzler et al. (2007) recommend native-speaking agents, as well as people who speak infant-directed speech rather than adult-directed speech are preferred (Schachner & Hannon, 2011). Infants are also capable of inferring others' social preferences or their affiliation based on their interaction and communication behaviors. The children between the ages of 15 and 18 months expect a connection between two babies who have been soothed by the same adult, or two adults who have soothed the same baby (Spokes & Spelke, 2017). Likewise, infants anticipate that characters will associate with those who have previously helped them and not with those who did not (Kuhlmeier et al., 2003). It is more likely that an infant will form an affiliation between two speakers of the same language than of two different languages, according to Liberman et al. (2017). Despite this, early social cognitive researchers have paid little attention to infants' affiliation expectations regarding third parties based on speech types. It is important to note also that there was no communicative context in the study of Spokes and Spelke (2017) involving a conversation-like dialogue.

According to Soley and Sebastian-Galles (2020), infants expect IDS to be addressed to an infant and ADS to be addressed to an adult, even when non-native language is used. In their experiment, infants (12–15 months) watched animated videos featuring adults talking to infants or other adults while they looked at each other. At times (congruent), the adult addressed the infant figure or the other adult figure with IDS or ADS. Other times (incongruent), the adult addressed the infant figure or the other adult figure with IDS or ADS. The infants in both groups were more likely to look at events that were incongruent than those that were congruent.

That is to say, infants infer that the infant-directed speech is an appropriate speech style for infants.

Based on these findings, this thesis asks whether infants expect another infant to choose appropriate social partner. In other words, do infants expect another infant to favor an adult who communicates with them using the appropriate speech style (infant-directed) over another adult who communicates with the baby using adult-directed speech? Preliminary In a pilot study conducted by Aldan et al. (2020), the following results were obtained: 14-to-18-month-old infants hold assumptions about other people's affiliative decisions based on the speech register in which they are addressed. However, this study was unfinished due to COVID-19 and involved a very small number of infants ($N = 9$). This thesis aims to further investigate the research question of this study using different methodologies such as lab-based and online looking time measures.

1.5 Online infant testing

While most infancy research takes place in the laboratory environment, online infant testing methods started to stand out as a promising tool for developmental scientists since it increases participant diversity and number while decreasing the expenses for both scientists and parents (Tran et al. 2017). Online testing is a relatively new method in infancy research. While platforms and software are still developing, there is some research demonstrating the feasibility of online testing methods for infants. It has been shown by research by Tran et al. (2017) that Mturk can be used to recruit and test infant populations quickly. They examined the possibility of recruiting infant populations more rapidly and assessing their behavior using the online platform Amazon Mechanical Turk (Mturk). Even though the number of cases excluded in

this study is high to some degree, it was the first study that intended to use online methods for infant testing. Following that, especially during the pandemic, many other researchers attempted to find tools to test infants outside the laboratory. ManyBabies Consortium is one of the pioneers of these attempts. The goal of ManyBabies at Home was to enhance and expand the infant's online testing process. Similar to this, Scott et al. (2017)'s Families could participate in behavioral studies through the Lookit platform via webcam. The Lookit platform has been found to measure looking time, preferential gazing, and vocal responses accurately in newborns (11–18 months), toddlers (24–36 months), and preschoolers (36–60 months) (Zaadnoordijk et al., 2021). These initiatives not only provide resources for online testing but also revealed some advantageous aspects of online testing to overcome constraints of infancy research such as limited sample sizes.

When compared to in-lab testing, online testing has several advantages. The first benefit is enlarging the sample size and diversity (Zaadnoordijk et al., 2021). Before online testing tools, contributing to infancy research has been only available to local parents who can visit the university campus which restricts the circle substantially. Online testing, on the other hand, allows parents from numerous backgrounds, regions, cities and even countries to participate in developmental studies. This also widens the diversity of participants since the number of families who have access to the internet exceeds the number of families who can arrange a visit to the laboratory significantly (Türkiye İstatistik Kurumu [TÜİK], 2021). Secondly, the time consumption of the study for both parents and researchers decreases in online studies with the ease of flexibility in time and location. Parents can arrange the appointment in their own time as in lab studies, but the time of study reduces almost by two-thirds since the road and preparation phases decline notably.

Finally, another benefit of online studies is the readiness of infants to participate in a study. Despite researchers implementing some protocols to comfort infants in laboratories and prepare for the experiment, it is not always possible to prevent fussiness. Since online experiments are being carried out at the infants' homes or any place infants already feel safe, the expected fussiness probability declines remarkably.

Although online testing seems to be cost-effective in many terms, researchers using a new method should provide convincing evidence to claim that their results are as valid as other methods that have been proven to be valid (Byers-Heinlein et al., 2022). Converging evidence across different measurements is one of the best methods for this (Havron, 2022; LoBue et al., 2020). Stemming from there, here we start by assuming that if online research methods have validity to an acceptable degree, then they should yield comparable results with in-lab methods since in-lab methods are assumed to have external validity to some point (Kominsky et al., 2022).

A limited number of previous studies have shown that online infant studies yield similar results to in-lab studies. For instance, Chuey et al. (2021) discovered in their online tests that infants favor agents with helpful intentions above those who produced good results, as was the case in Woo and Spelke's (2020) in-lab study. A similar observation was made by Smith-Flores et al. (2021) in their online replication research of Spelke et al. (1992), in which infants appeared to look longer at accidents involving objects that broke the theory of gravity.

1.6 Moderated Online Data Collection

Given the greater necessity to manage numerous testing environment factors, infant testing has mostly been limited to the physical laboratory space. The development of many tools to test infants online is promising. However, experiments still need to find a way to control the environment of testing. With regard to the degree of control, two types of online testing seem to be possible: moderated or unmoderated. While unmoderated studies have some advantages such as ease of recruitment, control of environmental factors is left to the initiative of the family, ending up with a decline in data quality. For instance, the very first online infant testing study by Tran et al. (2017) recruited the unmoderated tool Mturk indicated that although hiring was simple, the quality of the data suffered. Numerous participants (~ 40% of the data) had to be omitted from the analysis due to the limited ability to regulate participant and equipment screening online. Moderated online studies, on the other side, provide great control over the testing environment compared to unmoderated studies. In these studies, participants use video-conferencing applications like Zoom, Adobe Connect, or Skype to communicate with researchers in real time on a web-enabled device (Chuey et al., 2021). As a result of the live communication, experimenters can give instructions in addition to the guides that have been sent before the session. Considering this difference between moderated and unmoderated studies, conducting a moderated online study seems to be more logical if circumstances permit it.

CHAPTER 2

THE PRESENT STUDY

This thesis explores infants' assumptions about others' affiliative decisions based on the speech register in which they are addressed. Using past research to show that infants themselves prefer individuals who use IDS over those who use ADS for addressing them (Schachner & Hannon, 2011), and expect IDS to be directed to infants (Soley & Sebatish-Galles, 2020), we predicted that infants might also expect other infants more likely to be affiliated with adults who addressed the target infants using IDS. To test this research question, we conducted three experiments.

Experiment 1 was an online-moderated version of Aldan et al. (2020). A violation of expectation paradigm was used for this looking-time study. During the study, an experimenter demonstrated the procedure live to families via Zoom during a video call. Infants' looking times were measured online via web cameras during the affiliation actions between infant and adult characters following the familiarization trials, where the communicative style of each adult was presented to infants over a watch party website.

Experiment 2 was a laboratory-based study adding new data to Aldan et al. (2020). It used the same stimuli and method as in Experiment 1.

Experiment 3 employed an eye-tracking method and aimed to recruit multiple measures to examine our question as well as making arrangements in the design to facilitate the inference processes of infants. Researchers have recently begun to consider how phasic pupillary responses relate to psychological processes. The study by Jackson and Sirois (2009) showed that 8-month-old infants exhibit greater pupil dilations when they observe an impossibility (a train entering and exiting the same

tunnel). Pupil dilation is also used to assess infants' responses to social violations (Gredebäck & Melinder 2010). Based on these results, The pupil diameter method was combined with the looking time measure in experiment 3 to assess infants' perception of congruent and incongruent events more accurately than could be achieved with just looking times alone. Since the stimuli of the current study contained simplified animated objects (Kominsky et al., 2022), it provides sufficient size and margin for the accuracy eye-trackers require.

Experiment 3 was designed taking into account the results of Experiment 1 and 2 and it employed unmoderated eye-tracking version of the task with asynchronous video presentation while infants' pupil diameter was recorded simultaneously using the Tobii Fusion Lab. In addition, infant crying voice in trials has been changed with a daily babbling voice in order to emphasize the communicative concept more.

Infants between the ages of 14 and 18 months took part in the experiments. Developmental psychologists have studied testing infants extensively between the ages of 14 and 18 months because social cognition and the ability to draw conclusions about others' mental states are believed to develop during this period (Baillargeon, 2004; Onishi & Baillargeon, 2005). Infants are capable of understanding when someone else has opinions, goals, or objectives that may be different from their own at this age (Meltzoff, 1995). Additionally, they have the capacity for joint attention (Bakeman & Adamson, 1984) and the ability to discern when other people are focused on the same thing as them (Butterworth & Jarrett, 1991). For instance, a study by Kuhlmeier, Wynn, and Bloom (2003) showed that infants at this age expected a third party to help or hinder another agent based on their previous interactions.

Ethical permissions for the study were taken from Boğaziçi University Ethics Committee for Master's and Ph.D. Theses in Social Sciences and Humanities (Experiment 3, see Appendix A) and from the Boğaziçi University Institutional Review Board for Research with Human Subjects (Experiments 1 and 2, see Appendix B).

2.1 Experiment 1: Online Looking-time Study

Given the practical constraints due to COVID19 pandemic at the time, a violation of expectation paradigm was employed in Experiment 1 and was adapted from Aldan et al. (2020). Infants were first familiarized with the animated events of three geometric shapes that represented two adults and one baby. In these events, one of the adult characters communicated with the crying infant character using infant-directed while the other adult used adult-directed speech. After watching these events, during test events, infants saw the infant character approaching and jiggling slowly along with one of the two adult characters. The looking times of infants to these accidents had been recorded and compared. Based on past research suggesting that infants look longer to inconsistent compared to consistent social events (Mascaro & Csibra, 2012; Powell & Spelke, 2013; Spokes & Spelke, 2017; Soley & Sebastian-Galles, 2020; Thomsen et al., 2011), we expected infants to look longer at events where the infant character approached the adult that previously used ADS, in contrast to events in which the infant character approached an adult that used IDS in the past.

2.1.1 Method

2.1.1.1 Participants

A total of 23 infants (9 girls; mean age: 15 months, 24 days; range: 14 months, 12 days to 17 months, 22 days) were included in the analysis. We also tested 11 additional infants, but they were excluded because of technical errors [3], fussiness [5] or parent interference [3]. The sample size was determined based on sample sizes of past studies examining infants' pupillary responses or looking times to social stimuli (N = 24 in Jackson and Sirois, 2009; N = 16 in Hamlin et al., 2007; N = 24; in Gredebäck and Melinder, 2010).

According to parental reports, the final sample was composed of healthy, full-term infants, without hearing impairments, and coming from Turkish-speaking homes at least 90% of the time. Testing was conducted using Zoom.

2.1.1.2 Materials and Stimuli

In all experiments, parents filled out a questionnaire about their infants' hearing and language history as well as about demographic information (see Appendix C).

Sound recordings were taken from the stimuli which were originally created for ManyBabies Native Languages Follow-up (MB1N) (Soderstrom et al., 2022) project. Original recordings were collected from 22 mothers with their infants between 4-8 months at the Baby and Child Development Laboratory. Mothers were presented with 10 objects (5 familiar and 5 unfamiliar items) placed in a bag. Each mother took each object out of the bag one at a time and talked about the object, either to their baby or to the experimenter. The order of IDS and ADS was balanced between moms, and the objects were selected in random order. The final stimuli were created by following the procedure of MB1N (Soderstrom et al., 2022). First, sound

fragments were rated. Two research assistants listened to all the fragments and selected the “good” ones (rated them on IDSness and noisiness) and excluded others if they included the baby’s name or had background noise such as coughing. Then, 50 adults were recruited for rating the remaining segments. Each rater was assigned randomly to one of the five variables: accent, affect, naturalness, noisiness, and IDSness. The sound fragments were rated on a 7-point Likert scale on one of the five variables. Based on the ratings from the tasks, utterances were created. Utterance was rated as close to “standard Turkish” as possible. There was a high rating for naturalness. There was very little noise and there were consistently distinct differences between IDS and ADS clips. Following that 8 IDS and 8 ADS recordings that meet these criteria were selected. Once all the recordings have been selected, all clips were adjusted to 70dB, resampled at 44.1kHz, 100 sample precision, and RMS is adjusted to 70dB. All files were concatenated for each stimulus in the established sequence.

The stimulus generation of the current experiment was performed by selecting 8 clips (4 IDS and 4 ADS), each lasting 10 seconds, from these sound recordings.

Videos were adapted from Soley and Sebastian-Galles (2020) and consisted of three oval-shaped characters with eyes, as in many infant studies (Mascaro & Csibra, 2012; Powell & Spelke, 2013; Spokes & Spelke, 2017; Thomsen et al., 2011). The animations were prepared on Keynote software. Test videos were four 28-second-long animated videos, while familiarization videos were 8 59-second-long animation videos.

A yellow rectangular figure (14 cm 7 cm) rotated with a chime before disappearing (3 s) in the middle of the display against a steady black background

during the familiarization videos (59 s). The display began with two oval figures entering one after another over the course of three seconds, one large (13,5 cm 10 cm) and the other small (6 cm 4 cm). A green figure emerged from the bottom (15 s), while a red/blue figure emerged from either the upper right or the upper left side. The figures then took turns bouncing up once and then returning to their starting places (4 s). Then, the big figure turned its gaze to the small figure and pulsed along with an adult sound (10 s) either infant-directed or adult-directed. Each big figure appeared from a different side in each of the two familiarization videos, but the order in which they appeared changed. Eight familiarization videos with equal duration (59 sec.) were reencoded with Adobe Video Encoder for usability in different testing tools. The small figure approached one of the other figures in the test videos by going to the right or left corner of the screen and jiggling at the same time with them (7 s). All three characters were visible on the screen. Then, for nearly 21 seconds, the two characters remained motionless and silent.

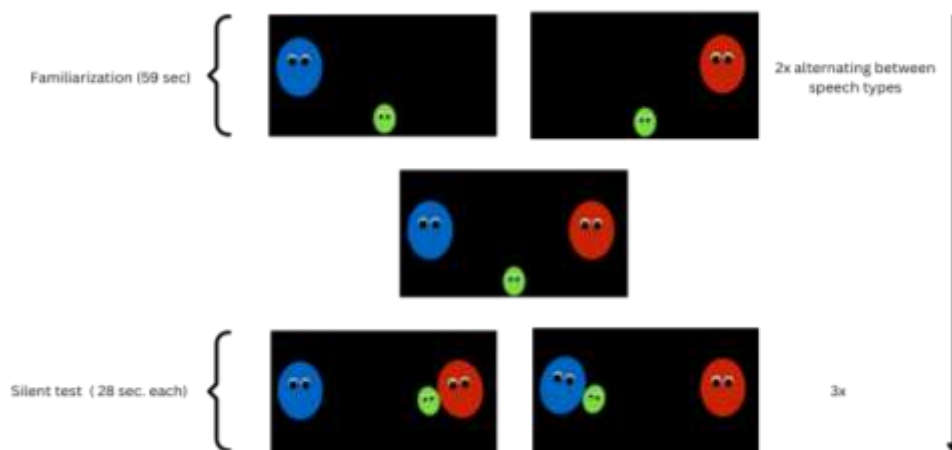


Fig. 1. Depiction of the experiment 1 and experiment 2 videos.

2.1.1.3 Design

Infants were presented with four familiarization trials with 8 different familiarization videos. Each familiarization trial consisted of the speech of one of the adult characters following the baby character's crying. There were two blocks of familiarization trials in the following order: IDS-ADS-ADS-IDS (or vice versa) subsequently after the crying. In other words, the speech registers were presented in a counterbalanced order to infants. The color and the lateral positions of the adult character (blue vs. red) that was associated with ADS and IDS, were counterbalanced too, resulting in 2 (order) by 2 (color) by 2 (lateral position) design. Eight different conditions occurred as a result of all balancing.

Following the familiarization trials, infants watched 3 blocks of test videos each consisting of one congruent and one incongruent event. We created 4 different test videos. Two alternative test conditions were produced as a result of the presentation order of the congruent and inconsistent videos being counterbalanced. Sixteen different orders were yielded as a result of all counterbalancing.

2.1.1.4 Procedure

Four familiarization trials were conducted before the experiment began. The duration of familiarization trials was fixed, however; as the test phase was designed to be an infant-controlled experiment, infants themselves determined the test trials' durations (max. 28 s). Once the participant infant spent 2 seconds looking away from the screen. During test trials, the program automatically terminated the video and moved forward to the next test video. Thereby, the total duration of test trials became dependent on infants' gaze. The embedded webcam of the display beneath the parents' computer screen was utilized to monitor and record the infants' looking

times. To ensure the blindness of the online coder to the conditions presented to infants, stimuli were presented via a second shared screen which is covered with a piece of black fabric.

Infants watched experimental stimuli created on Pyhab via a “watch party” website (<https://w2g.tv>). Watch party links were opened in a web browser full screen by the participant’s parent so that their infant would only see the stimulus, and then have the infant seated on their lap or a highchair located opposite the Zoom webcam (about 70 cm away), in a dim and quiet room in their own home. Looking time was recorded while the infant watched visual and aural stimuli using a camera that targeted at the infant’s face. During the session, infants’ looking times were coded simultaneously with Pyhab. Pyhab enabled us to carry out a gaze-contingent, moderated online looking time study. To ensure the blindness of the online coder to the conditions presented to infants, stimuli were presented via a second shared screen which is covered with a piece of black fabric.

2.1.1.5 Data Coding

Off-line frame-by-frame coding was performed by an experimenter (blinded to the condition) using Datavyu (Datavyu Team, 2014). These were then converted to seconds.

2.1.1.6 Data Preparation

Raw data were processed in Excel. First, we log-transformed all the looking-time scores of each Block (1, 2 & 3) and Condition (Congruent vs. Incongruent). Then we calculated the percentages of each condition within each block to ease the graphication. During test trials, if infants looked less than 2 seconds for a given trial, we excluded that trial and the matching trial in the same block. In other words, if on a congruent trial, an infant exhibited less than 2 seconds attention, we excluded that trial as well as the congruent trial in the same block. This was done because it took the infant figure about 2 seconds to start moving.

2.1.2 Results

We performed regression analyses on the trial-level data using jamovi (version 1.2.22; Jamovi, 2020) and GAMLj module 2.0.1 (Galluci, 2020), developed in R (R, 2019) and containing the lme4 package (Bates et al., 2015). There were fixed effects for Block, Speech-type, and their interaction, as well as a random intercept for the Participant. First, we analyzed infants' fixations during the familiarization phase. For this, an LMM analysis was run. We included logarithmic looking times as the dependent variable and added fixed effects of block and speech-type as well as the interaction between block and speech-type. We included Participant as a random effect. The analysis revealed no significant main effect of Block ($F(1, 66) = 0.09, p = 0.76$, Cohen's $d = 0.0549$) or Speech-type ($F(1, 66) = 0.96, p = 0.32$, Cohen's $d = 0.253$). Similarly, there was no significant interaction between Block and Speech-type (Block1-IDS: $M = 27.4$ s, $SE = 0.64$ s; Block1-ADS: $M = 27$ s, $SE = 0.77$ s; Block2-IDS: $M = 27.4$ s, $SE = 0.77$ s; Block2-ADS: $M = 26.7$ s, $SE = 0.76$ s; $F(1, 66)$

= 0.08, $p = 0.77$, Cohen's $d = 0.071$) (Fig. 2). Thus, infants watched familiarization trials involving IDS and ADS similarly.

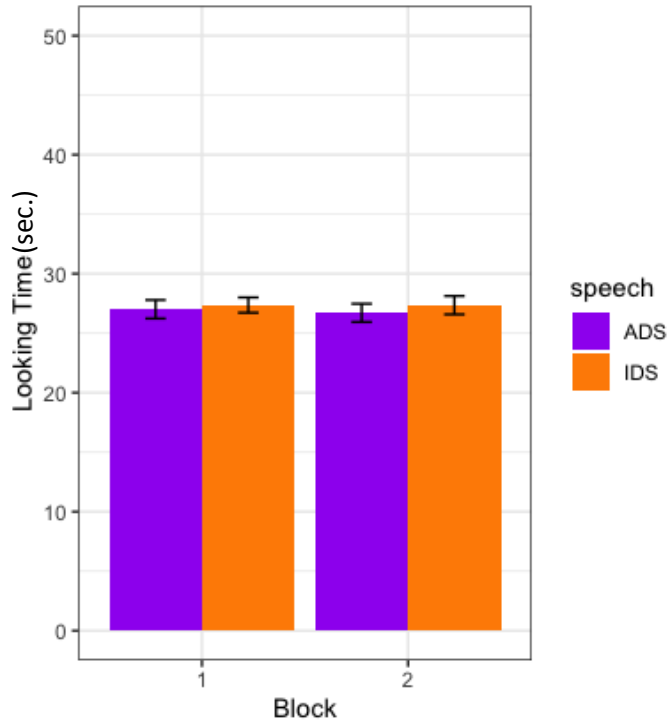


Fig.2. Mean looking times during familiarization trials of online looking-time study. Error bars represent standard error. All $ps > 0.05$.

Following this, we analyzed fixation times during the test phase. Fixation times less than 2 seconds were excluded due to the fact that the direction of infant character's approaching become detectable after 2 seconds of each test trial.

We performed regression analyses on the trial-level data using jamovi (version 1.2.22; Jamovi, 2020) and GAMLj module 2.0.1 (Galluci, 2020), developed in R (R, 2019) and containing the lme4 package (Bates et al., 2015).

A linear mixed model was fitted to examine the relationship between log-transformed looking time and various predictors. The model included a fixed intercept, as well as fixed effects for Block, Condition, presentation order of congruent condition; "Order", and their interactions (block:condition, block:order,

condition:order, and block:condition:order). Additionally, a random intercept was included to account for individual variability (Participant).

The model was estimated using Restricted Maximum Likelihood (REML) with the bobyqa optimizer, and it successfully converged to a solution.

The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values were calculated to assess model fit. The AIC was -20.56, and the BIC was 64.01. The log-likelihood was 2.06, indicating the goodness-of-fit of the model.

The R-squared values were used to assess the variance explained by the fixed effects. The Marginal R-squared was 0.170, representing the proportion of variance explained by the fixed effects alone, while the Conditional R-squared was 0.428, indicating the proportion of variance explained by both the fixed and random effects together.

The specific effects of block, condition, order, and their interactions were examined.

First, the fit of two linear mixed models (with and without the fixed effect of Order) was compared. A likelihood ratio test was conducted to compare the fit of model 1 (including the Order variable) and model 2 (Order is not included), yielding a likelihood ratio value of 8.71. The associated p-value was 0.19, indicating that the difference in fit between the two models was not statistically significant at the conventional threshold of $p < 0.05$. In other words, Order was not contributing the model. Therefore, we dropped the Order from the model and proceeded with the model included a fixed intercept, as well as fixed effects for block, condition, and their interaction.

For the final model, the AIC was -23.84, and the BIC was 25.26. The log-likelihood was 6.83, indicating the goodness-of-fit of the model.

The Marginal R-squared was 0.131, representing the proportion of variance explained by the fixed effects alone, while the Conditional R-squared was 0.393, indicating the proportion of variance explained by both the fixed and random effects together.

The analysis (see Table 1) revealed a significant main effect of Block ($F(2, 104) = 12.57, p < 0.001$, Cohen's $d = 2.810132$) suggesting that infants fixated longer during the first Block ($M = 18.5$ s, $SE = 1.19$ s) compared to the second Block ($M = 14.4$ s, $SE = 1.25$ s, $t(104) = 4.18, p < .001$) and third Block ($M = 12.1$ s, $SE = 1.21$ s, $t(103) = 4.98, p < .001$). However, the mean difference between Block 2 and Block 3 was not significant ($t(105) = 1.93, p = 0.16$).

There was no significant main effect of Condition (congruent: $M = 14.6$, $SE = 1.12$; incongruent: $M = 15.3$, $SE = 1.12$; $F(1,102) = 1.33, p = 0.25$, Cohen's $d = 0.2454144$) or significant interaction between Block and Condition ($F(2,102) = 0.66, p = 0.51$, Cohen's $d = 1.104532$) (Fig. 3).

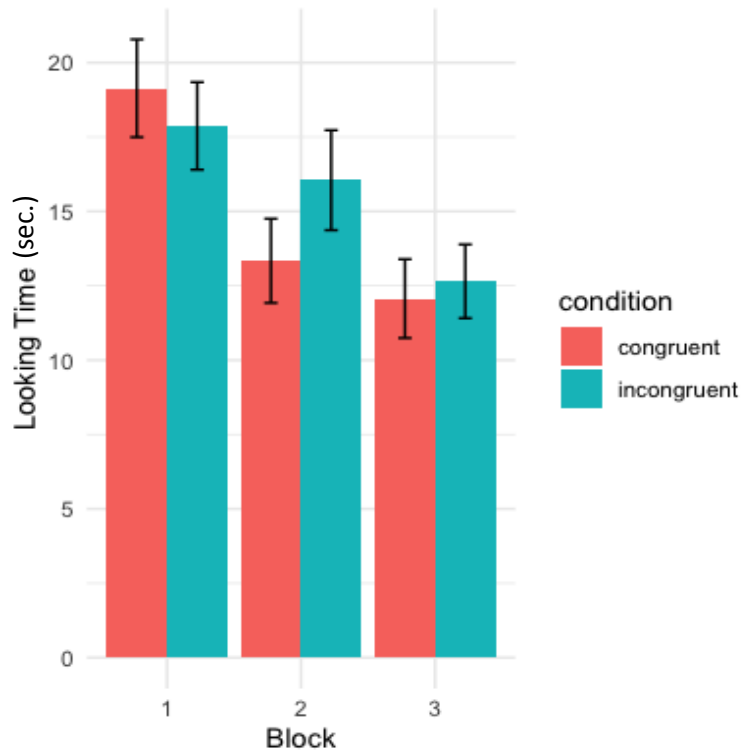


Fig.3. Mean looking times during test trials of online looking-time study. Error bars represent standard error. All $ps > 0.05$.

2.2 Experiment 2: Laboratory-based Looking-time Study

2.2.1 Methods

2.2.1.1 Participants

There were 19 infants included in the final analysis (11 girls; mean age: 15 months, 10 days; range: 14 months, 6 days- 17 months, 23 days). 9 additional infants were examined but did not make it into the final sample because of technical issues [1, prematurity [1, fussiness [6,] or parental interference [1]. Infants in the final sample were healthy, full-term, and did not have a history of hearing loss, according to parental reports, and they came from households that spoke Turkish at least 90% of the time. Testing took place at the Baby and Child Development Laboratory at Boğaziçi University.

2.2.1.2 Stimuli

These were identical to Experiment 1.

2.2.1.3 Design

These were identical to Experiment 1.

2.2.1.4 Procedure

These were identical to Experiment 1 except for the changes in testing which are detailed below.

Parents sat with their infants on their laps in a soundproof, softly lit room. There was a 27-inch monitor in front of the infant, approximately 70 centimeters away. A centrally located loudspeaker was hidden underneath the monitor. Monitors were equipped with integrated web cameras that record infants' attention to displayed events. In the experiment, parents wore noise-cancelling headphones (Sennheiser PXC 480), and were instructed to remain silent and not intervene. Room lighting was kept constant across participants.

2.2.1.5 Data Coding

These were identical to Experiment 1.

2.2.1.6 Data Preparation

These were identical to Experiment 1.

2.2.2 Results

We performed regression analyses on the trial-level data using jamovi (version 1.2.22; Jamovi, 2020) and GAMLj module 2.0.1 (Galluci, 2020), developed in R (R, 2019) and containing the lme4 package (Bates et al., 2015). There were fixed effects for Block, Speech-type, and their interaction, as well as a random intercept for the Participant. First, we analyzed infants' fixations during the familiarization phase. For this, an LMM analysis was run. We included logarithmic looking times as the dependent variable and added fixed effects of block and speech-type as well as the interaction between block and speech-type. We included Participant as a random effect. The analysis revealed no significant main effect of Block ($F(1, 54) = 3.9, p = 0.053$, Cohen's $d = 0.706$) or Speech-type ($F(1, 54) = 0.43, p = 0.51$, Cohen's $d = 0.1667$). Similarly, there was no significant interaction between Block and Speech-type (Block1-IDS: $M = 26.2$ s, $SE = 0.0.8$ s; Block1-ADS: $M = 26.8$ s, $SE = 0.69$ s; Block2-IDS: $M = 24.9$ s, $SE = 1.17$ s; Block2-ADS: $M = 25.2$ s, $SE = 0.9$ s; $F(1, 54) = 0.04, p = 0.82$, Cohen's $d = 0.0634$) (Fig. 4).

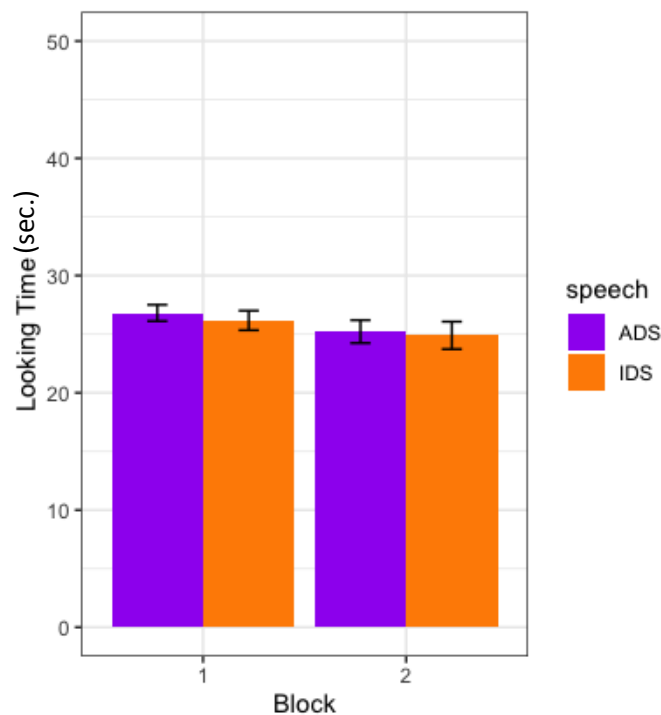


Fig.4. Mean looking times during familiarization trials of laboratory-based looking-time study. Error bars represent standard error. All $ps > 0.05$.

Following this, we analyzed fixation times during the test phase. Fixation times less than 2 seconds were excluded due to the fact that the direction of infant character's approaching become detectable after 2 seconds of each test trial.

We performed regression analyses on the trial-level data using jamovi (version 1.2.22; Jamovi, 2020) and GAMLj module 2.0.1 (Galluci, 2020), developed in R (R, 2019) and containing the lme4 package (Bates et al., 2015).

A linear mixed model was fitted to examine the relationship between log-transformed looking time and various predictors. The model included a fixed intercept, as well as fixed effects for block, condition, order, and their interactions (block:condition, block:order, condition:order, and block:condition:order). Additionally, a random intercept was included to account for individual variability (Participant).

The model was estimated using Restricted Maximum Likelihood (REML) with the bobyqa optimizer, and it successfully converged to a solution.

The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values were calculated to assess model fit. The AIC was 35.212, and the BIC was 107.520. The log-likelihood was -21.524, indicating the goodness-of-fit of the model.

The R-squared values were used to assess the variance explained by the fixed effects. The Marginal R-squared was 0.132, representing the proportion of variance explained by the fixed effects alone, while the Conditional R-squared was 0.414, indicating the proportion of variance explained by both the fixed and random effects together.

The specific effects of block, condition, order, and their interactions were examined.

Firstly, the fit of two linear mixed models (with and without the fixed effect of Order) was compared. A likelihood ratio test was conducted to compare the fit of model 1 (including the Order variable) and model 2 (Order is not included), yielding a likelihood ratio value of 6.43. The associated p-value was 0.37, indicating that the difference in fit between the two models was not statistically significant at the conventional threshold of $p < 0.05$. In other words, Order was not contributing to the model. Therefore, we dropped the Order from the model and proceeded with the model including a fixed intercept, as well as fixed effects for block, condition, and their interaction.

For the final model, the AIC was 29.644, and the BIC was 72.387. The log-likelihood was -17.7, indicating the goodness-of-fit of the model.

The Marginal R-squared was 0.101, representing the proportion of variance explained by the fixed effects alone, while the Conditional R-squared was 0.384, indicating the proportion of variance explained by both the fixed and random effects together.

The analysis revealed a significant main effect of Block ($F(2, 80.2) = 7.15, p < 0.001$, Cohen's $d = 1.864452$), indicating that throughout the first block ($M = 15.6$ s, $SE = 1.41$ s), infants were more fixated compared to the third block ($M = 10.1$ s, $SE = 1.50$ s, $t(79.8) = 3.75, p < 0.001$), but looking times during second block ($M = 11.8$ s, $SE = 1.54$) and third block did not differ ($t(78.7) = 1.57, p = 0.36$). Similarly looking times during first block and second block did not differ ($t(80.4) = 2.05, p = 0.13$).

There was no significant main effect of Condition ($F(1, 77) = 0.25, p = 0.61$, Cohen's $d = 1.107382$). There were no significant differences between the congruent and incongruent conditions in either the first block (congruent: $M = 16.4, SE = 1.73$; incongruent: $M = 14.75, SE = 1.73$; $t(76.2) = 1.10, p = 1.000$), second block (congruent: $M = 12.4, SE = 1.91$; incongruent: $M = 11.27, SE = 1.91$; $t(76.2) = 0.23, p = 1.000$), or the third block (congruent: $M = 9.69, SE = 1.86$; incongruent: $M = 10.43, SE = 1.86$; $t(76.2) = -0.4, p = 1.000$).

There was no significant interaction between Block and Condition ($F(2, 77) = 0.55, p = 0.57$, Cohen's $d = 0.5632411$) (Fig. 5).

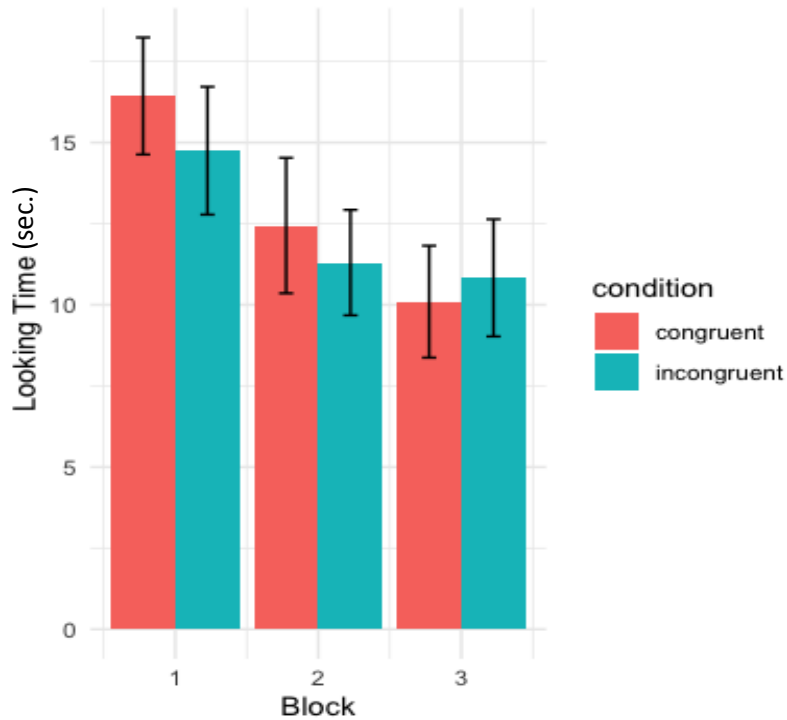


Fig.5. Looking times during test trials of laboratory-based looking-time study. Error bars represent standard errors. All p s > 0.05.

2.3 Experiment 1 versus Experiment 2

We performed regression analyses on the trial-level data using jamovi (version 1.2.22; Jamovi, 2020) and GAMLj module 2.0.1 (Gallucci, 2020), developed in R (R, 2019) and containing the lme4 package (Bates et al., 2015). Models had fixed effects for Block, Condition, Experiment and their interaction, as well as a random intercept for the Participant.

The analysis revealed a significant main effect of Block ($F(2, 183.6) = 17.67$, $p < 0.001$, Cohen's $d = 0.7408$), suggesting that during the first block ($M = 17.1$ s, $SE = 0.93$ s), infants seemed to fixate longer compared to the second block ($M = 13.2$ s, $SE = 1$ s, $t(188) = 3.31$, $p < 0.05$) and the third block ($M = 11.2$ s, $SE = 0.97$ s, $t(186) = 5.9$, $p < 0.001$). However, looking times during second block and third block did not differ ($t(186) = 2.37$, $p = 0.057$).

There was no effect of Experiment ($F(1, 82.1) = 1.13, p = 0.29$, Cohen's $d = 0.3704$).

There was no significant main effect of Condition ($F(1, 177.1) = 0.06, p = 0.8$, Cohen's $d = 0.0652$ and no significant interaction between Block and Condition ($F(2, 177.1) = 1.04, p = 0.35$, Cohen's $d = 0.2151$), also no effect of Experiment ($F(1, 82) = 1.13, p = 0.29$, Cohen's $d = 0.0458$), Experiment and Block ($F(2, 183.6) = 0.03, p = 0.96$, Cohen's $d = 0.000$), Experiment and Condition ($F(1, 177.1) = 1.16, p = 0.28$, Cohen's $d = 0.219$). The interaction between Block, Congruency and Experiment also did not yield a significant result ($F(2, 177.1) = 0.15, p = 0.85$, Cohen's $d = 0.048$).

2.4 Interim Discussion

The objective of Experiment 1 and 2 was to examine infants' third-party inferences based on infant-directed communication using behavioral methods.

In Experiments 1 and 2, infants fixated to the events for the same amount of time regardless of whether they were congruent or incongruent. Except for the overall higher looking times during Experiment 1 compared to Experiment 2, the results were similar across the two experiments. The replication of theoretically important findings is an essential aspect of scientific progress (Crivello & Poulin-Dubois, 2018).

The lack of condition effect on infants' looking times is a consistent result in both of our experiments. Therefore, while noting that our online looking-time experiment yielded comparable results to our laboratory-based experiment it is important to point some possible stimuli or measurement related explanations to this non effect. It is a well-known finding that infants are highly sensitive to the gaze direction (Astor & Gredebäck, 2019; Del Bianco et al. , 2019; Hood et al. 1998).

They also anticipate that during a talk, a person is going to look at her social companion (Beier & Spelke, 2012). However, in neither of our experiments adult and infant characters were gazing at each other or were at the same level while communicating. Accordingly, the lack of condition effect on infants' looking times to the events may stem from the insufficiency of social cues caused by agents' on-stage positions. Another stimulus related issue might be the crying voice of infant character. While we expect infants to make inferences based on communication, adult characters' speech following the crying sound of infant might prevented the formation of a communication-like context. In addition to all these, measuring looking-times alone may have caused to fail to detect effect of condition. More precise measurements (e.g. pupillary) can be recruited to overcome this limitation. The design of the next experiment was created considering all these limitations. Firstly, characters have been recreated and aligned to be face to face and gazing each other during trials. Secondly, infant character's crying voice has been changed with a babbling voice to create a conversation-like communication context. Finally, we decided to measure both looking times and pupil dilations of infants through eye tracking since pupillometry is a more sensitive method than looking-time measurements for our age group (Hepach & Westermann, 2013; Jackson & Sirois, 2009)

2.5 Experiment 3: A Pupil Size Study

Exploring more about infants' social expectations and evaluating their responses more closely is the reason for running the current eye tracking experiment. While previous experiments have examined infants' social expectations through looking time measures, eye tracking provides a more detailed and precise approach by

allowing researchers to track infants' moment-by-moment fixations, fixation shifts, and pupil size (Woo et al., 2023). According to Hepach and Westermann (2013), the looking time measurement failed to differentiate the incongruent circumstances in which an angry actor performs a positive action or and congruent circumstances in which actors perform actions consistent with their displayed emotions . However, in measurements of pupil size, only 14-month-olds, not 10 month-olds, preferentially displayed larger pupil dilation in response to incongruent occurrences. Similarly, Krüger et al. (2019) found that 1 years olds' looking times did not differ between trials showing animal images with corresponding or discordant animal sounds but they demonstrated different pupil sizes to mismatching and matching stimuli. Therefore, by using eye tracking, the current study can explore more about infants' social evaluation during congruent and incongruent events and provide a more comprehensive understanding of their social expectations.

Autonomous nervous systems affect pupil size (Hepach & Westermann, 2016). Research has shown that children's pupil size increases when they see unexpected or inconsistent events (Krüger et al.2020). Hence, we investigate infants' pupil diameters before and during both congruent and incongruent conditions. A MATLAB-based program, TimeStudio (version 3.23, www.timestudioproject.org), was used to calculate these values (Nyström et al., 2016).

The pupil size measurement experiment recruits the same method as the in-lab looking time study except for the following changes. Familiarization trials started with the infant figure on the screen, the adult characters came up to the scene later. In order to emphasize communicative context, crying sound of baby was replaced with a babbling sound of a Turkish speaking baby. The infant character turned its gaze to the adult character before babbling. Similarly, the adult figures turned their gazes to

the infant figure before responding with either IDS or ADS. In the test trials, there were still images instead of videos to ease the pupil size measurements. In the still images, the infant character was seen standing still right next to one of the adult characters. The figures were staring fixedly down during the test. The test trials were not infant-controlled, but had a fixed duration of 15 seconds. As a final improvement, infants were only given 2 test trials instead of 3.

2.5.1 Method

2.5.1.1 Participants

Participants were 24 full-term and healthy infants (15 males; mean age = 15.9 months, range = 14.2–17.6) between 14 months and 18 months without history of hearing impairment and coming from predominantly (min. 90%) Turkish-speaking families. A further 5 infants who achieved calibration were eliminated due to low tracking ratios (N = 2; below 30 %), experimenter errors (N = 1), or fussiness (N = 2). For the analyses on pupil dilation, tracking ratios of 30% were considered satisfactory (LoBue et al., 2017, who used a 15% cut-off for 4-to-24-month-olds).

2.5.1.2 Calibration

A short video was played before the stimulus was displayed to draw the infants' attention to the screen and ensure the eye-tracker was recording their gaze. The eye-tracker was calibrated using a five-point calibration process, which included a colorful center rattle and corners of the screen. Data loss of zero degrees or less qualified as a successful calibration. Calibrations were repeated for inattentive infants until satisfactory results were achieved. The stimulus presentation began after calibration.

2.5.1.3 Stimuli

Four 15-second-long static images served as the test stimuli, while 16 animation videos lasting 53 seconds served as the familiarization stimuli. Keynote software was used to create videos that featured three geometrically shaped figures with eyes, like in numerous infant studies (Mascaro & Csibra, 2012; Powell & Spelke, 2013; Spokes & Spelke, 2017; Thomsen et al., 2011). From Soley and Sebastian-Galles (2020), figures were obtained. A rectangular, yellow figure (14 cm x 7 cm) with a sound-assisted rotation stands in the center of a solid black background in the familiarization videos before dissipating after three seconds. After this brief introduction, a scene was shown that began with a green, small (6 cm 4 cm), oval figure standing still in the center of the screen. In the following three seconds, a big (13,5 cm by 10 cm) red or blue figure appeared from either the right or left side. The figures then took turns between rising once while making a bouncing sound and then falling back to their starting positions (4 s). Then, after pulsing for about five seconds and making babbling sound, the small figure turned its gaze towards the bigger figure. The big figure then shifted its gaze to the smaller one and pulsed along with an adult sound (10 s), either infant- or adult-directed. Each big figure appeared from the same side in both familiarization videos, but their order of appearance was different. Two big figures and a small one appeared on the screen simultaneously in the test videos. Next to one of the big figures was the small figure. The silence and stillness of this still image lasted for 15 seconds (Fig. 6).

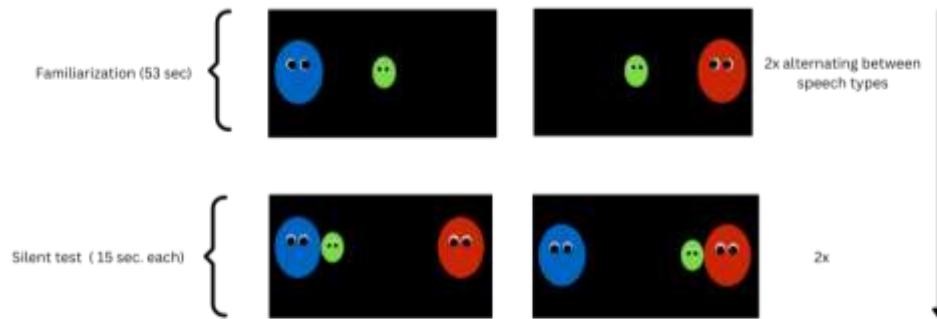


Fig. 6. Depiction of the experiment 3 stimuli.

2.5.1.4 Design

The design of familiarization trials was identical to Experiment 1 and Experiment 2. However, the design of test trials was slightly different.

Following the familiarization trials, infants watched 2 blocks of test videos each consisting of one congruent and one incongruent event. We created 4 different test videos, in which the character colors and sides that were associated with IDS and ADS were counterbalanced. A counterbalanced presentation order was used for videos that were congruent and incongruent. As in previous experiments, all counterbalancing yielded 16 different orders.

2.5.1.5 Procedure

In a room with low lighting, infants were examined. A laptop with a 15.6" screen was located approximately 60 cm in front of the infants who sat in a highchair.

Sitting behind an infant, parents were asked not to interfere with their children.

Through noise-canceling headphones (Sennheiser PXC 480), parents listened random

speech samples accompanied by music. Participants experienced the same level of lighting in the room. The experiment started with four familiarization trials (53 s). The number of familiarization trials were fixed. Similarly, as the experiment is designed to be unmoderated experiment, infants were presented with all test videos, each lasting for 15 seconds. The duration of the test videos determined by calculating the mean looking times of infants in Experiment 1 and Experiment 2. Infants watched attention-getters between each familiarization and test blocks (10 s). Tobii Pro Fusion Lab monitored and recorded the pupil size.

2.5.2 Results

R Studio was used to conduct the data analyses (Rstudio Team, 2020). By using linear mixed-effects models, participants' individual variability can be taken into account and data can be assessed trial by trial. Compared to methods that use aggregate analysis over trials, this methodology yields a more accurate analysis (Baayen et al., 2008).

For looking time analysis raw data of all the looking-time scores of each Block (1 & 2) and Condition (Congruent vs. Incongruent) were log-transformed.

First, we analyzed infants' fixations during the familiarization phase. For this, an LMM analysis was run. The dependent variable was logarithmic looking times, and fixed effects of Block and Speech-types were added along with an interaction between Block and Speech-type. We included Participant as a random effect.

According to the analysis, Block did not have any significant main effects ($F(1, 69.9) = 0.89, p = 0.34$) or Speech-type ($F(1, 69.9) = 2.56, p = 0.11$). Similarly, there was no significant interaction between Block and Speech-type (Block1-IDS:M = 16.1

s, $SE = 1.23$ s; Block1-ADS: $M = 14.9$ s, $SE = 1.15$ s; Block2-IDS: $M = 15.4$ s, $SE = 1.3$ s; Block2-ADS: $M = 14.4$ s, $SE = 1.3$ s; $F(1,69.9) = 0.02$, $p = 0.88$) (Fig. 7).

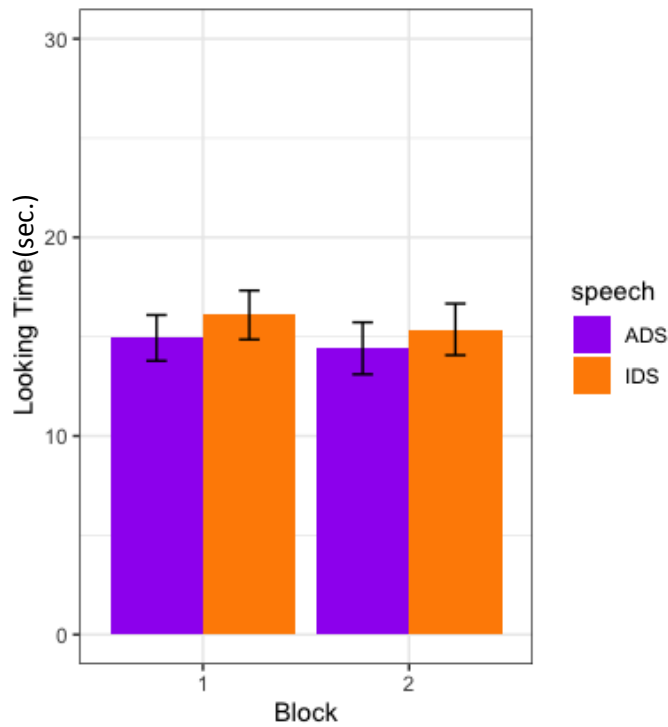


Fig.7. Mean looking times during familiarization trials of eye-tracker looking-time study. Error bars represent standard error. All $ps > 0.05$.

We performed regression analyses on the trial-level data using jamovi (version 1.2.22; Jamovi, 2020) and GAMLj module 2.0.1 (Galluci, 2020), developed in R (R, 2019) and containing the lme4 package (Bates et al., 2015).

A linear mixed model was fitted to examine the relationship between log-transformed looking time and various predictors. The model included a fixed intercept, as well as fixed effects for block, condition, order, and their interactions (block:condition, block:order, condition:order, and block:condition:order). Additionally, a random intercept was included to account for individual variability (Participant).

The model was estimated using Restricted Maximum Likelihood (REML) with the bobyqa optimizer, and it successfully converged to a solution.

The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values were calculated to assess model fit. The AIC was 113.77, and the BIC was 156.46. The log-likelihood was -55.84, indicating the goodness-of-fit of the model.

The R-squared values were used to assess the variance explained by the fixed effects. The Marginal R-squared was 0.118, representing the proportion of variance explained by the fixed effects alone, while the Conditional R-squared was 0.425, indicating the proportion of variance explained by both the fixed and random effects together.

The specific effects of block, condition, order, and their interactions were examined.

Firstly, the fit of two linear mixed models (with and without the fixed effect of Order) was compared. A likelihood ratio test was conducted to compare the fit of model 1 (including the Order variable) and model 2 (Order is not included), yielding a likelihood ratio value of 6.43. The associated p-value was 0.38, indicating that the difference in fit between the two models was not statistically significant at the conventional threshold of $p < 0.05$. In other words, Order was not contributing the model. Therefore, we dropped the Order from the model and proceeded with the model included a fixed intercept, as well as fixed effects for block, condition, and their interaction.

For the final model, the AIC was 109.9, and the BIC was 136.4. The log-likelihood was -54.8, indicating the goodness-of-fit of the model.

The Marginal R-squared was 0.04, representing the proportion of variance explained by the fixed effects alone, while the Conditional R-squared was 0.43,

indicating the proportion of variance explained by both the fixed and random effects together.

The analysis revealed a significant main effect of Block ($F(1, 71.4) = 4.52, p < 0.05$), indicating longer looking times in the first block ($M = 7.37, SE = 0.68$) compared to the second block ($M = 5.43, SE = 0.62$). There was no significant main effect of Condition ($F(1, 62.5) = 0.94, p = 0.336$), and no significant interaction between Block and Condition ($F(1, 62.5) = 0.96, p = 0.330$).

Pairwise comparisons of the simple main effects of condition were conducted within each level of Block using lsmeans. Congruent and incongruent conditions did not differ significantly in either the first block (congruent: $M = 7.08, SE = 0.81$; incongruent: $M = 7.66, SE = 0.81$; $t(62.5) = 0.008, p = 1.000$) or the second block (congruent: $M = 6.60, SE = 0.649$; incongruent: $M = 6.27, SE = 0.651$; $t(63.4) = 1.41, p = 0.96$), a significant effect of the condition was not observed on looking time (Fig. 8).

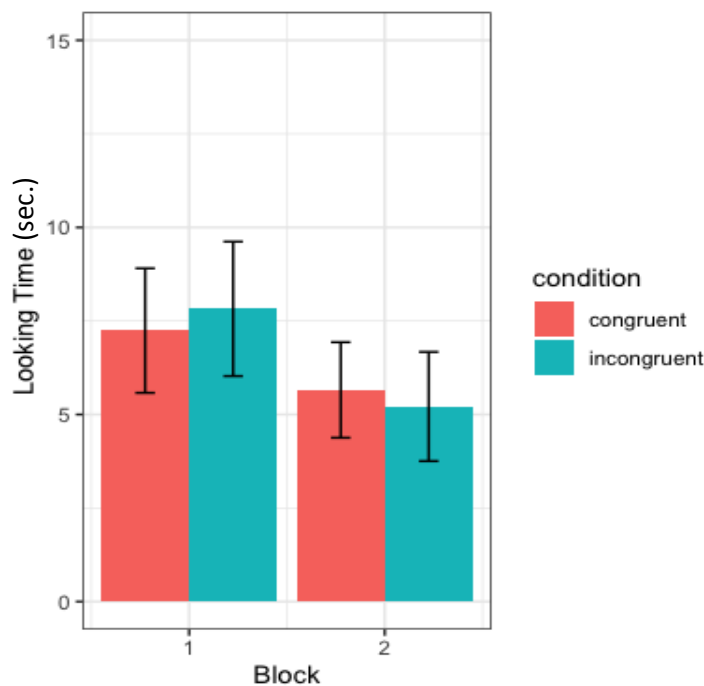


Fig. 8. Looking times during test trials of experiment 3. Error bars represent standard errors. All $ps > 0.05$.

2.5.2.1 Pupil Dilation

2.5.2.1.2 Data Preparation

Preprocessing methods, settings, and TimesStudio study have been adapted from Fawcett and Kreutz (2021) for pupillary analysis. We used TimeStudio (TimeStudio version 3.21, timestudioproject.com, Nyström et al., 2016) to process Tobii Studio's raw data, an open-source MATLAB time series data processing tool. Our first step was to linearly fill any gaps in the pupil size data that were less than 5 samples before smoothing the data with a moving average over 20 samples. The average pupil sizes during the target time period were subtracted from the average pupil sizes during the baseline period to determine the pupil reaction scores. For the testing trials, the baseline was the -8.8 to -7.8 seconds of the previous attention-getter. This time window was selected since it has the lowest pupil diameter scores in all time ranges (Fig. 7). Establishing a baseline by selecting a time range with the lowest pupil diameter scores before the pupil size change occurred, is a form of baseline correction (Gilzenrat et al., 2010). According to Gilzenrat et al. (2010), by using baseline correction, it is possible to verify that any pupil size changes that occur are a result of the test stimuli, rather than just individual differences. The analysis phase lasted between 10 and 15 seconds of second block. The time range with the highest pupil diameter scores (last 5 seconds) (Fig. 9) was chosen because It probably reflects the peak of the pupil's response to the test stimuli. This time range is expected to capture the most reliable and consistent change in pupil size across trials since this method had lower measurement error and higher correlation between repeated measurements (Mathôt et al., 2018). Previous research has shown that the peak of the pupil response typically occurs between 2 to 6 seconds after the onset of a stimulus, with the exact timing depending on various factors such as the nature of

the stimulus and the individual differences in the participant's physiology (Bach, 1996; Beatty & Lucero-Wagoner, 2000; Steinhauer et al., 2004). However, in the current study, the peak occurred in the last 5 seconds. This could happen for several reasons: First reason might be the complexity of the stimuli, given that the events involved third party social inferences. The processing time required for a stimulus to reach its peak response in the pupil can depend on the complexity or subtlety of the stimuli (e.g., Hess & Polt, 1960). More complex or subtle stimuli may require more processing time before reaching their maximum effect on the pupil response (Porter et al., 2010). Second, differences in baseline pupil size might have caused this shift. The timing of the peak response can also be influenced by individual differences in baseline pupil size. Participants with larger baseline pupil sizes may take longer to reach their peak response compared to those with smaller baseline sizes (Relaño-Iborra et al., 2022).

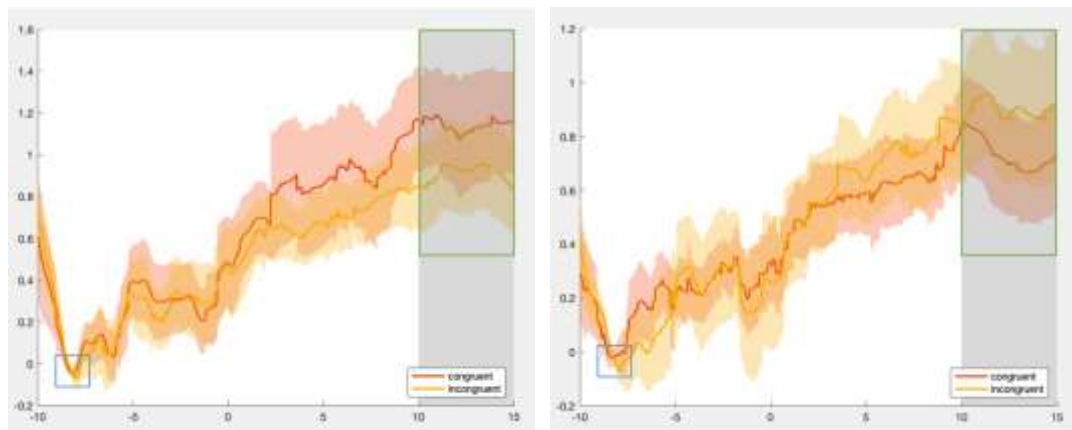


Fig. 9. Pupil size changes during the attention-getter and test trials of block 1 (left) and block 2 (right). Colored frames show the lowest and highest pupillary response intervals.

2.5.2.1.3 Pupil Dilation Results

We used a linear mixed-effects model with Pupil size as the dependent variable, Condition and Block as the independent variable, and Participant as a random intercept.

Our results showed that no effect of Condition on Pupil size $F(1, 32.2) = 0.91, p = 0.34$). The effect of Block on Pupil size was also not significant ($F(1, 34.1) = 1.97, p = 0.16$)

Our model revealed a significant interaction between Block and Condition ($F(1, 31.9) = 4.62, p = 0.03$), resulting in a larger pupil diameter in incongruent condition compared to the congruent condition (incongruent: $M = 1.16, SE = 0.16$; congruent: $M = 0.76, SE = 0.13$) in Block 2 (Fig. 10). Pupil diameters did not differ in the first block (incongruent: $M = 1.07, SE = 0.14$; congruent: $M = 1.20, SE = 0.15$.)

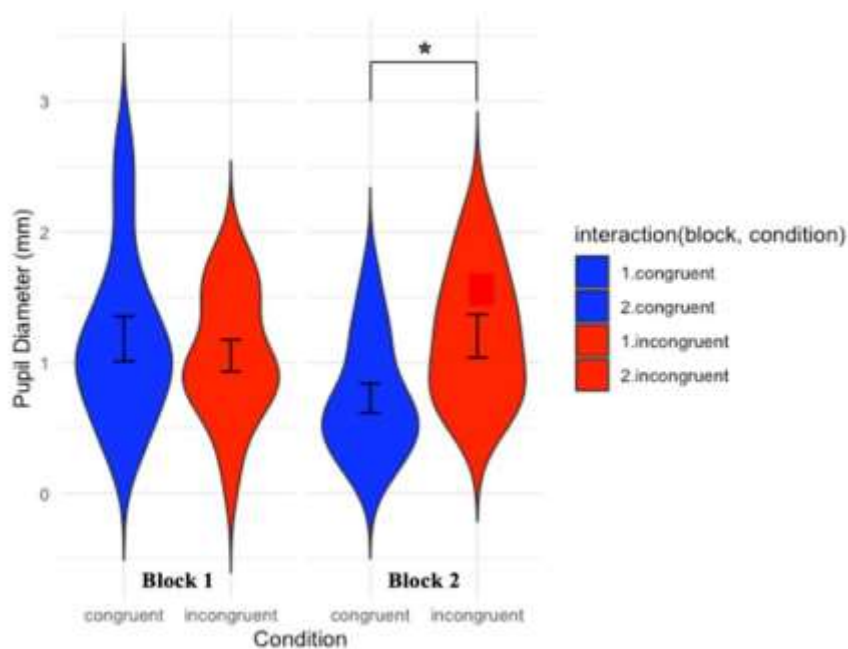


Fig. 10. Infants' pupillary responses to congruent and incongruent events of experiment 3. Error bars represent standard errors. $*p < 0.05$.

Accordingly, Experiment 3 revealed that in the second block, infants exhibited greater pupil dilation during the incongruent events, whereas their looking times were similar. In order to see the looking time patterns of infants with higher attentional level (pupil dilation > 1), we have selected 13 infants with larger pupil dilation scores and run the analysis with these infants once again. We performed regression analyses on the trial-level data using jamovi (version 1.2.22; Jamovi, 2020) and GAMLj module 2.0.1 (Galluci, 2020), developed in R (R, 2019) and containing the lme4 package (Bates et al., 2015). There were fixed effects for Block, Condition, and their interaction, as well as a random intercept for the Participant. The analysis revealed a significant main effect of Block ($F(1, 39) = 5.5, p < 0.05$, Cohen's $d = 0.6188699$), indicating longer looking times in the first block ($M = 7.12, SE = 0.87$) compared to the second block ($M = 5.78, SE = 0.86$). There was also a significant main effect of Condition ($F(1, 38) = 7.46, p < 0.05$, Cohen's $d = 0.683374$), but no significant interaction between block and condition ($F(1, 38) = 0.69, p = 0.41$, Cohen's $d = 0.08944272$).

Pairwise comparisons of the simple main effects of Condition were conducted within each level of Block using lsmeans. Congruent and incongruent conditions produced significantly different results in the first block (congruent: $M = 6.08, SE = 0.96$; incongruent: $M = 8.16, SE = 0.96$; $t(38.5) = 3.57, p < 0.05$). There was marginally significant effect of condition in the second block (congruent: $M = 5.27, SE = 0.95$; incongruent: $M = 6.28, SE = 0.95$; $t(38) = 2.56, p = 0.08$), indicating that the condition has a significant effect on looking times (Fig. 11).

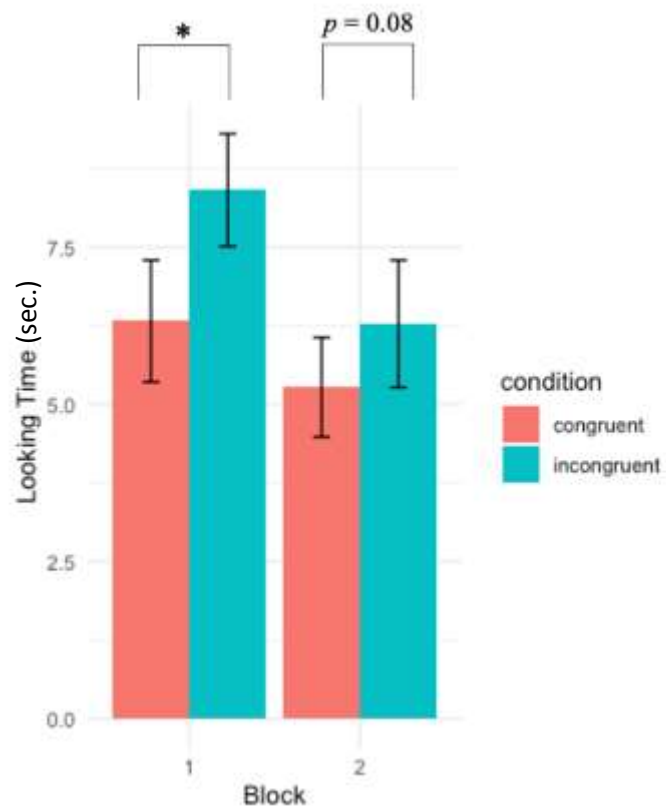


Fig. 11. Looking times of participants with larger pupil dilation during test trials of Experiment 3. Error bars represent standard errors. $*p < 0.05$.

CHAPTER 3

DISCUSSION

This study sought to determine whether infants expect to be given preference to an adult who uses IDS when communicating with a baby over a different adult who uses ADS. Across three experiments, we used a Violation of Expectation (VoE) paradigm. After familiarizing infants with two adults communicating with a baby using either IDS or ADS, we measured infants' attention to events where the baby approached one of the two adults across trials. Experiment 1 was an online experiment that found no difference in infant attention levels to events in which the baby approached either adult. Experiment 2 was an in-lab study, and using the same methodology, it also failed to find any difference in infants' gaze patterns. Finally, Experiment 3 both implemented some changes in the stimuli and the design and used eye tracking to measure looking time as well as infants' pupil dilations. This experiment also did not yield an expectation regarding third parties' affiliations in infants' looking time. The second block of Experiment 3 showed that infants' pupils dilate more when confronted with incongruent events than when confronted with congruent ones. Interestingly, when we analyzed the data of infants with larger pupil dilation, we observed that those infants also showed consistent looking patterns and gazed more to incongruent events compared to congruent events. The findings suggest that infants' expectations regarding affiliation to IDSs are inconsistent. On the other hand, They also suggest that different methodological tools provide more or less consistent results. First, in-lab and online studies yielded similar findings, and this can be promising for the future of infant research. Second, pupil dilations and

looking time patterns also align, however, still pupil dilation might provide a more sensitive measure.

The fact that we couldn't see any differences between the looking-time patterns of socially incongruent and congruent events because infants are incapable of making such inferences from complex social scenes is unlikely. In fact, past research suggests that infants at this age and at even younger ages, make quite rich social interpretations of events and use a variety of cues to form social expectations. For instance, Gazes et al. (2015) found that 10- to 13-month-olds show greater looking times to the incongruent event in which social dominance hierarchy was violated compared to the congruent events. Similarly, in the study of Vouloumanos and Bryant (2019), the social scene that was incongruent since two strangers exhibited laughter made infants look longer compared to the congruent social scenes where two friends exhibited laughter. Likewise, Rhodes et al. (2015) found that when infants aged 16 months were introduced to events involving conflict between the members of different pairs as well as cooperation within pairs they looked longer when members of the between-pair who had never interacted before now worked together, rather than conflicted as expected, with one another. Furthermore, previous research has shown that infants can infer affiliation between third parties. When children are between 15 and 18 months of age, for instance, they anticipate a bond between two infants who were soothed by the same individual or between two individuals who soothed the same infant (Spokes & Spelke, 2017). Similarly, Kuhlmeier et al. (2003) showed that infants assume that characters would associate with who helped them and not those that did not in the past. Finally, Liberman et al. (2017) found that there is a greater likelihood of infants predicting affiliation between speakers of the same language than between speakers of different

languages. Nevertheless, it is crucial to note that our results come from three distinct experiments. Thus, our study demonstrated that it is possible to get comparable results in online looking time experiments with laboratory-based looking time experiments when a procedure accounting for control over the computer distance, silence, camera position and technical equipment was prepared. The reliability of online measures is still not completely established because we consistently found null results. Future studies are needed to reach a more reliable conclusion. In contrast with the looking-time results of our experiments, we found that infants' pupillary responses changed between congruent and incongruent conditions in Experiment 3. Since the screen and room luminance were held constant across conditions, this effect cannot be attributed to general luminosity differences. If we assume that pupil size measurement is more sensitive and thus yielded more reliable results, this finding suggests that infants form expectations about affiliative preferences based on speech register, similar to previous studies on infants' expectations regarding caregiving actions based on other cues (Johnson et al., 2007; Johnson et al., 2010). Moreover, the results confirmed those reported by Sebastian-Galles and Soley (2020), who found infants perceived IDS to be directed at an infant, while ADS to an adult. Infants often have a wealth of communication experiences by the time they turn one year old, including speech-like babble in which they sync their movements with the speech of others (e.g., Feldstein et al., 1993; Jaffe et al., 2001). Engaging in these proto conversations, might evoke the awareness of speech's primary role in communication and create expectations about its role in others' affiliations. Nevertheless, there are also reasons for this expectation not being very strong. Thorgrimsson et al. (2015) showed, for instance, that infants expect

communication to be targeted and responsive by the time they reach one year of age. However, this expectation only become salient in a face-to-face context.

From a methodological perspective, pupil size results of Experiment 3 provide support to the idea that by measuring pupil size, we are able to more accurately interpret infants' perceptions of congruent and incongruent events than simply observing their looking times. However, an old question from the developmental research arises again after our results: "Why do young children simultaneously perform well and poorly on tasks designed for assessing the same knowledge?" (Munakata et al., 1997). A likely explanation can be made by taking into account the measurement sensitivity difference between VoE paradigm looking time and pupillometry. Comparing pupillometry to behavioral methods, Sirois & Jackson (2012) reported that pupillometry provides more convenient and resourceful results. For instance, Krüger et al. (2019) found that 1 years olds' looking times did not differ between trials showing matched and mismatched stimuli while they demonstrated different pupil sizes to these stimuli. The researchers concluded that the contradictory results might suggest that pupillometry is a more sensitive method than looking-time measurements for this age group (Hepach & Westermann, 2013; Jackson & Sirois, 2009). The fact that pupillary responses can be observed in shorter time periods (e.g. 5 sec) while looking-time measurement require longer durations, such as mean times of 20 seconds or greater (Onishi & Baillargeon, 2005) also supports this argument. All in all, the current study provides a first step towards understanding infants' affiliate expectations based on infant-directed communication by analyzing their pupillary responses in detail, serving as a starting point for exploring the nature of the infants' affiliation expectations.

These results may also indicate that infants' attentional processes are differentially influenced by cognitive effort or arousal, as reflected in pupil size, compared to visual fixation or attention allocation, as reflected in looking time. Somewhat contrasting findings of pupil size and looking time studies suggest that attention encompasses distinct components and manifests differently in different measures. The size of pupils has been proposed as a reliable indicator of cognitive effort or arousal in various contexts (Laeng et al., 2012; Gredebäck & Melinder, 2010). Observed larger pupil sizes in response to incongruent events indicate that infants were more engaged by the unexpected information presented in the events or experienced heightened cognitive effort. In contrast, looking time has been widely used to measure visual attention in infants and has been found to be associated with preferential fixation or allocation of attention to specific stimuli (e.g., Colombo et al., 2001). It appears that, in the current study, overall visual fixation or attention allocation did not differ significantly between incongruent and congruent events. Our studies indicate that multiple measures are essential for a comprehensive understanding of attentional processes. Our experiments may have provided a more nuanced understanding of how infants allocate cognitive effort, engage with stimuli, and process information by combining pupil size with looking time.

Age-related factors might have also contributed to the discrepancy between looking time and pupil dilation results. Krüger et al. (2019) notes that when children become 15 months old and older, it is often difficult, if not impossible, to assess their cognitive abilities using methods like violation of expectation (VoE) since older infants and toddlers typically avoid looking attentively at unexpected occurrences; instead, they turn to their parents or the experimenters instead. (Spelke et al., 1992). Similarly, 15-months and older infants have increasing mobility (Thelen et al., 1996)

and looking times measures become more challenging to use with these age groups. The fact that those infants with larger pupil dilation also showed increased attention to inconsistent events does not contradict this explanation, and might suggest that when infants were attentive enough, they in fact showed the expected patterns in both measures.

The fact that the speech stimuli in the present investigation were not actually collected from everyday conversations, but rather recorded from mothers while they are describing several objects raises some doubts. Infants' lack of affiliation inferences based on these speech segments might have been influenced by this. Therefore, it is also important to examine infants' affiliation expectations based on speech samples taken from daily conversations.

It is also important to note that the contrast regarding the looking times of incongruent and congruent conditions in each block of both online and laboratory experiments resulted in moderate to large effect sizes despite non-significant results. Thus, the results are unlikely to be driven by insufficient power. Nevertheless, future research with further control measures may be necessary to obtain a more reliable understanding of infants' affiliation expectations.

Finally, pupil size results in the current study should be interpreted cautiously. Pupil dilation can be affected from factors other than infants' inferences. For instance, pupil size dilation can vary across individuals due to factors such as temperament or developmental stage. Infants with higher levels of attentional control (Aston-Jones & Cohen, 2005) or those more experienced with social interactions may exhibit different pupil dilation patterns compared to others (Laeng et al., 2012; Sirois & Brisson, 2014). Indeed, we found that, in Experiment 3, infants with larger pupil dilations tended to pay more attention to incongruent events than congruent events.

These results emphasize the significance of looking at individual differences and their probable causes.

In sum, this study provides a direct comparison between different methodologies when examining infants' social expectations and contributes to research investigating the reliability of using online methodologies with infants. While the main question about infants' affiliation expectations based on speech register still stands aside, the current study showed that pupil size measurement provides more insights into infants' social expectations when compared to looking time.

APPENDIX A

ETHIC APPROVAL (EXPERIMENT 3)

Evrak Tarih ve Sayısı: 21.02.2023-114289

T.C.
BOĞAZİÇİ ÜNİVERSİTESİ
SOSYAL VE BEŞERİ BİLİMLER YÜKSEK LİSANS VE DOKTORA TEZLERİ ETİK İNCELEME
KOMİSYONU
TOPLANTI KARAR TUTANAĞI

Toplantı Sayısı : 40
Toplantı Tarihi : 08.02.2023
Toplantı Saati : 14:00
Toplantı Yeri : Zoom Sanal Toplantı
Bulunanlar : Prof. Dr. Feyza Çorapçı, Doç. Dr. Arhan S. Ertan, Doç. Dr. Senem Yıldız, Dr. Öğr. Üyesi
Yasemin Sohtorik İlkmen, Dr. Öğr. Üyesi Ayşegül Metindoğan
Bulunmayanlar :

Neslihan Oğuz
Psikoloji

Sayın Araştırmacı,

"Bebeklerin Bebek Yönelimli İletişime Dayalı Üçüncü Şahıslar Arasındaki İlişki Beklentileri: Bir Gözbebeği Ölçüm Çalışması " başlıklı projeniz ile ilgili olarak yaptığınız SBB-EAK 2023/20 sayılı başvuru komisyonumuz tarafından 8 Şubat 2023 tarihli toplantıda incelenmiş ve uygun bulunmuştur.

Bu karar üyelerin toplantıya çevrimiçi olarak katılımı ve oy birliği ile alınmıştır. Onay mektubu üye ve raportör olarak Yasemin Sohtorik İlkmen tarafından toplantıya katılan bütün üyeler adına e-imzalanmıştır.

Saygılarımızla, bilgilerinizi rica ederiz.

Dr. Öğr. Üyesi Yasemin
SOHTORİK İLKMEN
Öğretim Üyesi

e-imzalıdır
Dr. Öğr. Üyesi Yasemin Sohtorik
İlkmen
Öğretim Üyesi
Raportör

SOBETİK 40 08.02.2023

Bu belge, güvenli elektronik imza ile imzalanmıştır.

APPENDIX B

ETHIC APPROVAL (EXPERIMENT 1& EXPERIMENT 2)



T.C. BOĞAZIÇI ÜNİVERSİTESİ
Sosyal ve Beşerî Bilimler İnsan Araştırmaları Etik Kurulu (SBİNAREK)

18.02.2020

Dr. Öğr. Üyesi Gaye Soley
Boğaziçi Üniversitesi,
Fen-Edebiyat Fakültesi,
Psikoloji Bölümü,
34342 Bebek / İstanbul

Sayın Araştırmacı,

"Bebeklerle İletişim (Communicating with infants)" başlıklı projeniz ile Boğaziçi Üniversitesi Sosyal ve Beşerî Bilimler İnsan Araştırmaları Etik Kurulu (SBİNAREK)'e yaptığınız 2020-11 kayıt numaralı başvuru 17.02.2020 tarih ve 2020/02 sayılı kurul toplantısında incelenmiş ve projenize etik onay verilmesi uygun bulunmuştur.

Saygılarımızla, bilgilerinizi rica ederiz.

Doç. Dr. Osman Sabri Kıratlı (Başkan)
Uygulamalı Bilimler Yüksek Okulu
Uluslararası Ticaret Bölümü
Boğaziçi Üniversitesi, İstanbul

Prof. Dr. Hatoş Gökşen (Üye)
Fen Edebiyat Fakültesi
Sosyoloji Bölümü
Koç Üniversitesi, İstanbul

Dr. Öğr. Üyesi C. Taylan Acar (Üye)
Fen-Edebiyat Fakültesi
Sosyoloji Bölümü
Boğaziçi Üniversitesi, İstanbul

Dr. Öğr. Üyesi Işıl Erduyan (Üye)
Eğitim Fakültesi
Yabancı Diller Eğitimi Bölümü
Boğaziçi Üniversitesi, İstanbul

Dr. Öğr. Üyesi Selçuk Kaynak (Üye)
İktisadi ve İdari Bilimler Fakültesi
Siyaset Bilimi ve Uluslararası İlişkiler Bölümü
Boğaziçi Üniversitesi, İstanbul

Dr. Öğr. Üyesi Nur Soylu Yalçınkaya
Fen-Edebiyat Fakültesi
Psikoloji Bölümü
Boğaziçi Üniversitesi, İstanbul

Öğr. Gör. Dr. Suzan Üsküdarlı (Üye)
Mühendislik Fakültesi
Bilgisayar Mühendisliği Bölümü
Boğaziçi Üniversitesi, İstanbul

1 / 1

APPENDIX C

DEMOGRAPHIC INFORMATION QUESTIONNAIRE(TURKISH)

Bilgi Formu (Bilgileriniz gizli tutulacaktır.)

Bebeğinizin cinsiyeti: K ☐ E ☐ Bebeğinizin doğum tarihi:
____/____/____

Hamileliğinizin kaçınıcı haftasında doğum yaptınız? _____

Dil Bilgileri

Bebeğinizin Anadili: _____

Bebeğiniz zamanının yüzde kaçında kendi anadilini duyuyor? _____%

Bebeğiniz zamanının yüzde kaçında anadili dışında ikinci bir dil duyuyor? _____%

Bebeğinizin en çok duyduğu ikinci dil: _____

İkinci dil duyma sebebini yazınız (Örneğin, yabancı bakıcı, çift-dilli anne baba vb.:

Bebeğiniz zamanının yüzde kaçında yukarıdaki dillerden başka bir dil(ler) duyuyor:
_____%

Bebeğinizin duyduğu diğer dil(ler): _____

Sağlık Geçmişi:

Bebeğiniz doğduğundan itibaren bir ya da daha fazla kez kulak enfeksiyonu geçirdi mi? ☐ Evet ☐ Hayır

Bebeğinizin şu anda kulak enfeksiyonu var mı? ☐ Evet ☐ Hayır

Bebeğinizde bilinen herhangi bir görme ya da işitme bozukluğu var mı? ☐ Evet ☐ Hayır

Eğer varsa, lütfen açıklayın:

Bebeğinizin gelişimi hakkında herhangi bir endişeniz var mı? ☐ Evet ☐ Hayır

Eğer varsa, lütfen açıklayın:

Müzik bilgileri:

Bebeğinizle birlikte herhangi bir müzik dersi aldınız mı ya da alıyor musunuz? ☐ Evet ☐ Hayır

Evet ise,

açıklayınız _____

Bebeğinizin bulunduğu ortamda ne sıklıkta ve ne tür müzikler dinliyorsunuz?

Kardeşler

1. Kardeş Doğum Tarihi: _____

Cinsiyeti : K ☐ E ☐

2. Kardeş Doğum Tarihi: _____ Cinsiyeti : K ☐ E ☐
- 3.

Ebeveyn 1

Cinsiyet: K ☐ E ☐ Doğum tarihi ve yeri:

____/____/____, _____

Anadil(ler)i: _____

Eğitim seviyesi: ☐ İlkokul mezunu ☐ Ortaokul mezun ☐ Lise terk ☐ Lise mezunu

☐ Üniversite terk: ☐ Lisans mezunu ☐ Yüksek Lisans mezunu ☐ Doktora
mezunu

Diğer (lütfen açıklayınız): _____

Ebeveyn 2

Cinsiyet: K ☐ E ☐ Doğum tarihi ve yeri:

____/____/____, _____

Anadil(ler)i: _____

Eğitim seviyesi: ☐ İlkokul mezunu ☐ Ortaokul mezun ☐ Lise terk ☐ Lise mezunu

☐ Üniversite terk: ☐ Lisans mezunu ☐ Yüksek Lisans mezunu ☐ Doktora
mezunu

Diğer (lütfen açıklayınız): _____

Bu merdivenin Türkiye’de insanların sosyal ve ekonomik olarak bulunduğu konumları temsil ettiğini düşünün.

Merdivenin en üst basamağında sosyo-ekonomik olarak en iyi durumda olan yani en çok paraya, en yüksek eğitim seviyesine ve en saygı duyulan mesleklere sahip kişiler var. Merdivenin en alt basamağında ise; sosyo-ekonomik olarak en kötü durumda olanlar yani, en az paraya, en düşük eğitim seviyesine, en az saygı duyulan mesleklere sahip ya da işsiz kişiler var. Merdivende ne kadar üst basamaktaysanız, en iyi durumda olan kişilere o kadar yakınsınız, merdivende ne kadar alt basamaktaysanız, en kötü durumda olan kişilere o kadar yakınsınız demektir.

Kendinizi bu merdivenin hangi basamağına konumlandırırdınız?

Lütfen yaşamınızın bu döneminde Türkiye’deki diğer insanlara kıyasla kendinizi merdivenin hangi basamağında gördüğünüzü, o basamağa büyük bir “X” işareti koyarak belirtiniz



APPENDIX D

TRANSCRIPTIONS OF THE RECORDINGS

Speech Type	TRANSCRIPTIONS
ADS	Plastik ve sert bir top. Çok çok sert değil ama sert bir top. Topun özelliği yere vurdurduğunda içinde bir ışık var ve yanıp sönüyor o ışıklar. Kırmızı ve mavi...
IDS	Bak burada ne var? Senin en sevdiğin şey top. Bak senin ellerin gibi küçücük hem de. Gördün mü? Hop hop yapalım. Bununla gol yapabiliriz.
ADS	Bu da bir plastik. Hala aydede diyorum buna ama bu bir plastik Ay. Genelde bunları duvarlara yapıştırıyorlar. Fosforlu rengi olması sebebiyle ışıklar kapan...
IDS	Burada bir aydede var bak yeşil renkte. Gördün mü? Yine parlak. Sen çok seviyorsun böyle renkleri di mi annecim? Rengine bak. Senin odana da alalım mı böyle parlak?
ADS	Oyuncak bir top görüyoruz. Şeffaf, üzerinde desenler var. Bir bebeğin eliyle rahatça kavrayabileceği büyüklükte ve renkleri de yine aynı şekilde bir bebeğin ilgisini çekebilecek...
IDS	Pembe bir top, bizim toplara benziyor evdeki di mi? İçinde ışık varmış bak bird aha vuralım mı? Ah, bakar mısın yine yandı. Tekrar yanıp...
ADS	Karanlıkta da çok kolay bu cismi fark edebiliriz. Oldukça ince bir cisim bu. Hatta burada ağız burun detayları var, sivri köşeleri var. Bunların...

IDS	Aydede, hani bizim duvarımızda da var. Yıldızlar var aydede var bulutlar var. Yeşil bir aydede bu annecim.
-----	--

APPENDIX E

DESCRIPTIVE INFORMATION

Table E1. Descriptive for Laboratory-based Experiment

	block	condition	looking_time (sec.)
N	1	congruent	19
		incongruent	19
	2	congruent	15
		incongruent	15
	3	congruent	16
		incongruent	16
Mean	1	congruent	16.4
		incongruent	14.7
	2	congruent	12.4
		incongruent	11.3
	3	congruent	10.1
		incongruent	10.8
Std. error mean	1	congruent	1.80
		incongruent	1.97
	2	congruent	2.09
		incongruent	1.62
	3	congruent	1.73
		incongruent	1.81
Median	1	congruent	12.6
		incongruent	12.3
	2	congruent	10.3
		incongruent	10.7
	3	congruent	8.50
		incongruent	10.1
Minimum	1	congruent	7.08
		incongruent	2.20
	2	congruent	2.52
		incongruent	2.77
	3	congruent	2.00
		incongruent	2.64
Maximum	1	congruent	28.6
		incongruent	26.7
	2	congruent	28.6
		incongruent	24.3
	3	congruent	26.6
		incongruent	28.5

Table E2. Descriptive for Online Experiment

	block	condition	looking_time (sec.)
N	1	congruent	23
		incongruent	23
	2	congruent	20
		incongruent	20
	3	congruent	22
		incongruent	22
Mean	1	congruent	19.1
		incongruent	17.9
	2	congruent	13.3
		incongruent	16.0
	3	congruent	12.1
		incongruent	12.6
Std. error mean	1	congruent	1.64
		incongruent	1.47
	2	congruent	1.41
		incongruent	1.68
	3	congruent	1.32
		incongruent	1.24
Median	1	congruent	20.3
		incongruent	16.9
	2	congruent	12.1
		incongruent	12.5
	3	congruent	11.5
		incongruent	10.9
Minimum	1	congruent	3.28
		incongruent	8.59
	2	congruent	3.34
		incongruent	3.15
	3	congruent	2.78
		incongruent	4.10
Maximum	1	congruent	29.9
		incongruent	28.7
	2	congruent	27.3
		incongruent	29.0
	3	congruent	24.9
		incongruent	26.1

Table E3. Descriptive for Pupil Size Experiment Looking-time

	Block	Condition	Tracking ratio	Looking time (sec.)
N	1	congruent	23	23
		incongruent	23	23
	2	congruent	21	21
		incongruent	21	21
Mean	1	congruent	51.6	7.24
		incongruent	51.6	7.82
	2	congruent	49.8	5.65
		incongruent	49.8	5.21
Std. error mean	1	congruent	2.77	0.849
		incongruent	2.77	0.916
	2	congruent	2.58	0.651
		incongruent	2.58	0.744
Median	1	congruent	50	6.47
		incongruent	50	7.23
	2	congruent	51	4.88
		incongruent	51	6.42
Minimum	1	congruent	31	0.900
		incongruent	31	0.183
	2	congruent	31	0.267
		incongruent	31	0.0160
Maximum	1	congruent	74	13.3
		incongruent	74	14.7
	2	congruent	74	12.4
		incongruent	74	11.8

Table E4. Descriptive for Pupil Size Experiment Pupil Dilation

	Condition	Block	Pupil dilation(m m)
N	congruent	1	15
		2	14
	incongruent	1	15
		2	14
Mean	congruent	1	1.18
		2	0.727
	incongruent	1	1.05
		2	1.20
Std. error mean	congruent	1	0.173
		2	0.113
	incongruent	1	0.122
		2	0.165
Median	congruent	1	1.07
		2	0.633
	incongruent	1	0.925
		2	1.23
Minimum	congruent	1	0.293
		2	0.176
	incongruent	1	0.135
		2	0.645
Maximum	congruent	1	2.64
		2	1.66
	incongruent	1	1.80
		2	2.06

APPENDIX F

SUMMARIES OF FINAL MODELS FOR LMM ANALYSES

Table 1. The LMM Model Summary for Online Looking Time Analysis (Experiment 1)

Fixed Effects Parameter Estimates

Names	Effect	Estimate	SE	df	t	p
(Intercept)	(Intercept)	1.1190	0.0311	21.5	35.961	< .001
block1	2 - 1	-0.1192	0.0417	103.9	-2.860	0.005
block2	3 - 1	-0.2008	0.0403	102.3	-4.979	< .001
condition1	incongruent - congruent	0.0386	0.0335	101.5	1.153	0.251
block1 * condition1	2 - 1 * incongruent - congruent	0.0910	0.0824	101.5	1.105	0.272
block2 * condition1	3 - 1 * incongruent - congruent	0.0662	0.0804	101.5	0.824	0.412

Table 2. The LMM Model Summary for Laboratory-based Looking Time Analysis (Experiment 2)

Fixed Effects Parameter Estimates

Names	Effect	Estimate	SE	df	t	p
(Intercept)	(Intercept)	1.0093	0.0447	18.5	22.603	< .001
block1	2 - 1	-0.1224	0.0595	81.0	-2.057	0.043
block2	3 - 1	-0.2189	0.0582	80.4	-3.763	< .001
condition1	incongruent - congruent	-0.0239	0.0479	77.0	-0.500	0.619
block1 * condition1	2 - 1 * incongruent - congruent	0.0655	0.1164	77.0	0.563	0.575
block2 * condition1	3 - 1 * incongruent - congruent	0.1195	0.1143	77.0	1.045	0.299

Table 3. The LMM Model Summary for Lab vs. Online Experiment Analysis
(Experiment 1 vs. 2)

Fixed Effects Parameter Estimates						
Names	Effect	Estimate	SE	df	t	p
(Intercept)	(Intercept)	1.06964	0.0269	33.8	39.7445	< .001
block1	2 - 1	0.11954 ⁻	0.0360	185.2	-3.3161	0.001
block2	3 - 1	0.20710 ⁻	0.0351	182.5	-5.9075	< .001
condition1	incongruent - congruent	0.00736	0.0290	177.1	0.2536	0.800
experiment1	online - lab	0.04811	0.0452	82.1	1.0647	0.290
block1 * condition1	2 - 1 * incongruent - congruent	0.07829	0.0709	177.1	1.1043	0.271
block2 * condition1	3 - 1 * incongruent - congruent	0.09285	0.0694	177.1	1.3374	0.183
block1 * experiment1	2 - 1 * online - lab	0.00204 ⁻	0.0721	185.0	-0.0283	0.977
block2 * experiment1	3 - 1 * online - lab	0.01636	0.0702	182.6	0.2332	0.816
condition1 * experiment1	incongruent - congruent * online - lab	0.06255	0.0580	177.1	1.0780	0.283
block1 * condition1 * experiment1	2 - 1 * incongruent - congruent * online - lab	0.02550	0.1418	177.1	0.1798	0.857
block2 * condition1 * experiment1	3 - 1 * incongruent - congruent * online - lab	0.05321 ⁻	0.1389	177.1	-0.3832	0.702

Table 4. The LMM Model Summary for Eye-tracker Looking Time Analysis
(Experiment 3)

Fixed Effects Parameter Estimates						
Names	Effect	Estimate	SE	df	t	p
(Intercept)	(Intercept)	0.6571	0.0759	20.8	8.65	< .001
block1	2 - 1	-0.1802	0.0838	70.3	2.15	0.035
condition1	incongruent - congruent	-0.0784	0.0783	61.5	1.00	0.321
block1 * condition1	2 - 1 * incongruent - congruent	-0.1569	0.1566	61.5	1.00	0.320

Table 5. The LMM Model Summary for Eye-tracker Pupil Size Analysis
(Experiment 3)

Fixed Effects Parameter Estimates						
Names	Effect	Estimate	SE	df	t	p
(Intercept)	(Intercept)	1.058	0.0890	14.9	11.880	< .001
block1	2 - 1	-0.185	0.1315	34.1	-1.405	0.169
condition1	incongruent - congruent	0.125	0.1304	32.2	0.955	0.347
block1 * condition1	2 - 1 * incongruent - congruent	0.560	0.2602	31.9	2.150	0.039

Table 6. The LMM Model Summary for Eye-tracker Looking Time Analysis (Only Participants with high attentional levels) (Experiment 3)

Fixed Effects Parameter Estimates

Names	Effect	Estimate	SE	df	t	p
(Intercept)	(Intercept)	0.7054	0.0896	12.0	7.876	< .001
block1	2 - 1	-0.1182	0.0503	39.0	2.347	0.024
condition1	incongruent - congruent	0.1306	0.0478	38.0	2.732	0.009
block1 * condition1	2 - 1 * incongruent - congruent	-0.0796	0.0956	38.0	0.833	0.410

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