

Predictors and Outcomes of Pointing Behavior in Early Communicative Development: From
Child-Directed Interactions to Gestures to Words

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STATEMENT OF AUTHORSHIP

This thesis contains no material which has been accepted for any award or any other degree or diploma in any university or other institution. It is affirmed by the candidate that, to the best of her knowledge, the thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

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ABSTRACT

Human infants start pointing with their index-fingers by 10 to 14 months. However, social and cognitive origins of pointing gestures and the predictive role of pointing for early language are relatively unexplored. To elicit pointing in a constrained context from infants and their mothers, we used a semi-observational *Decorated Room* paradigm (Brown & Liszkowski, 2007). Additionally, we used a *Point Following* experiment (Mundy, 2003) to assess infants' ability to follow direction of adults' points to different locations; measured fine-motor skills using the *Mullen Scales of Early Learning* (Mullen, 1995); and collected maternal reports on infants' receptive and expressive language development using the *Turkish Communicative Developmental Inventory (T-CDI)* (Aksu-Koç, Küntay, Acarlar, Maviş, Sofu, Topbaş, & Turan, 2011). 35 mother-infant dyads (20 high-educated and 15 low-educated mothers) visited the lab three times when their infants were at 8, 10 and 12 months of age. We found that maternal education was not associated with the age of onset of infant pointings, the frequency of infant and mother pointings, and the infants' point following performance. Only a trend was found for infants with high maternal education to score higher in the fine-motor skills task than their agemates with low maternal education. Binary logistic regressions revealed that the increasing frequency of mothers' index finger pointings at 8 months increased the probability of infant pointing at 10 months. Infants who already started to point by at 10 months, in turn, more frequently followed the experimenter's pointings at 12 months. Correctly following the referent of pointing gestures at 12 months was associated with larger receptive vocabulary for action words at 12 months over and beyond maternal pointing frequency. We discuss these findings by suggesting that pointing is a dynamically developing communicative system, where several socio-cognitive variables interact to predict its time of emergence and frequency of display. We further argue that the relations between point

following and point production, and the relations between pointing and early language development, are bidirectionally associative.

Keywords: Pointing; Gestures; Preverbal Communication; Early Word Learning; Parent-Child Interaction

ÖZET

Bebeklerin 10 ve 14 ayları arasında işaret parmaklarını kullanarak nesneleri gösterme davranışı sergilemeye başladığı yaygın bir bulgudur. Ancak işaret etme davranışının sosyal ve bilişsel kökenleri ile işaret etme davranışının erken dil gelişimi üstündeki etkisi henüz çok araştırılmamıştır. Bu çalışmada anne ve bebeklerinin işaret etme davranışlarını gösterme eğilimlerini arttıran yarı-yapılandırılmış bir gözlem protokolü olan *Sergi Odası* (Brown&Liszkowski, 2007) yöntemiyle, anne ve bebeklerinin işaret etme davranışındaki farklılıklarını tespit ettik. *Basit İşaret Takibi* (Mundy, 2003) deneyi ile bebeklerin başkalarının işaret etme davranışlarını takip edebilmekteki performanslarını ve *Mullen Erken Öğrenme Ölçekleri* (Mullen, 1995) ile bebeklerin ince-hareket gelişimlerini ölçtük. Ayrıca Türkçe İletişim Gelişimi Envanteri (Aksu-Koç, Küntay, Acarlar, Maviş, Sofu, Topbaş & Turan, 2011) ile bebeklerin alıcı dil ve ifade edici dil gelişimlerini takip ettik. Eğitim seviyesi yüksek ($N = 20$) ve düşük ($N = 15$) 35 anne ile bebeği, bebekler 8, 10 ve 12 aylıkken üç kez laboratuara geldiler. Bebeklerin işaret etme davranışı göstermeye başlama yaşlarında, annelerin ve bebeklerinin işaret etme davranışlarının sıklığında ve bebeklerin başkalarının işaretlerini takip etme performanslarında annelerin eğitim seviyesine bağlı herhangi bir anlamlı farklılık bulunmamıştır. Sadece yüksek eğitilmiş annelerin bebeklerinin ince-hareket kabiliyetlerinin, düşük eğitilmiş annelerin bebeklerine kıyasla yüksek olduğuna dair bir eğilim bulunmuştur. İkili lojistik regresyon analizleri, annelerin 8 aylıkta işaret etme sıklığının bebeklerinin 10 aylıkta işaret etme davranışı gösterip göstermediğini yordadığını açığa çıkarmıştır. 10 aylıkken işaret etme davranışı gösteren bebekler ise, göstermeyenlere kıyasla, 12 aylıkta işaret takibi deneyinde daha iyi bir performans sergilemiştir. Bebeklerin 12 aylıkken bir yetişkinin işaret etme davranışının gösterdiği nesneyi doğru bir şekilde takip etme becerileri ise, annelerinin işaret etme sıklığının ötesinde, eylemler için alıcı dil becerilerini yordamıştır. Bu bulgular işaret etme davranışının ortaya çıkışının ve sıklığının,

birtakım sosyo-bilişsel değişkenlere bağlı olarak farklılık gösteren dinamik bir sistemle açıklanabileceğini göstermektedir. Aynı zamanda işaret etme ile başkasının işaret etme davranışını takip etme arasındaki ve işaret etme ile erken sözcük dağarcığı arasındaki ilişkilerin tek taraflı olmadığını ileri sürmektedir.

Anahtar Kelimeler: İşaret Etme; Jestler; Dil Öncesi İletişim; Erken Sözcük Öğrenimi; Anne-Bebek Etkileşimi

DEDICATION

*To my mother,
for her endless support*

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CHAPTER 1

INTRODUCTION

1.1. General Overview

Pointing gestures are nonverbal communicative signals that aim to direct the addressee's attention to an object or to an event, bringing the object or the event into the common ground of interactants. Pointing gestures take various forms such as whole hand pointing, middle finger pointing, chin, lip, head or eyebrow pointing. One particular form of canonical pointing, index-finger pointing, which is characterized by the extended index finger with a stretched arm and the palm down hand shape (Franco & Butterworth, 1996; Butterworth, 2003) has been regarded as a foundational building block of human communication. Researchers argue that index finger pointing is a major milestone on the road to communicative development, playing a major role in emergence of vocabulary (Iverson and Goldin-Meadow, 2005; Özçalışkan & Goldin-Meadow, 2005; Rowe & Goldin-Meadow, 2009b).

The present research strives to understand socio-cognitive differences between infants who predominantly point to items around them and those who have not yet displayed any pointing behavior. We are concerned with how pointing behaviors of infants at the age of 8 months, 10 months and 12 months relate to their developing skills in following others' pointing behaviors. Further we examine the influence of mothers' pointing behaviors on the infants' emerging pointing behaviors, as well on their skills in point following. We also investigate whether early vocabulary of infants (in terms of both comprehension and production) varies depending on the pointing behavior of infants and their mothers.

CHAPTER 2

LITERATURE REVIEW

2.1. How universal is index-finger pointing?

The index-finger pointing gesture has been argued to be a human-specific and universal communicative act. Some research entertains the possibility that the great apes, when raised in captivity, display index-finger points to a human agent, but only to request things from their human caregivers (Hopkins & Leavens, 1998; Povinelli, Bering & Giambrone, 2003; Gomez, 2007). Yet the observation that non-captive non-human primates do not point for each other in their natural habitats suggest that there are certain socio-cognitive and motivational components of pointing production and comprehension that make the index-finger pointing uniquely human.

There is a good amount of evidence that all human infants point with their index-finger by 12 to 14 months (Carpenter, Nagell, Tomasello, Butterworth, Moore, & Butterworth, 1998; Liszkowski, Carpenter, & Tomasello, 2007; Callaghan, Moll, Rakoczy, Warneken, Liszkowski, Behne, & Tomasello, 2011). However, Wilkins (2003) suggested that canonical index-finger pointing is not a dominant communicatory act even among our conspecifics. He observed among the speakers of Arrernte who reside in northern Central Australia, and among the indigenous cultures of Barai, Yimas and Watam of Papua New Guinea, pointing with chin or with pursed lips is more frequently displayed than index-finger pointing. Thus according to Wilkins (2003), index-finger pointing is not the prevalent mode of exophoric referring for all cultures. He further noted an anecdote arguing that Barai of Papua New Guinea do not comprehend the referential intent behind the index finger pointing behaviors of others (i.e. Mike Olson, a linguist, pointed with his index finger in order to get the name of an object yet he could not attract the Barai's attention although his lip-pointing was successful in engaging the interaction).

Wilkins (2003) also raised the possibility of the suppression of index finger pointing by some cultural factors in his discussion of the lip-pointing dominant cultures. For example in some cultures pointing to a person with hand is not a commonplace act of communication; it is even culturally unacceptable particularly if the person pointed is high in authority. It is perhaps because in these cultures pointing is thought to be directed to objects and when an index-finger is pointed to a person this is thought to degrade him down to the status of an object. Likewise English speaking cultures do not point with their middle fingers unless their index fingers are occupied (e.g. while holding an object) most probably due to the offensive connotation middle finger pointing brings about. However, Arrernte speakers were observed to use their middle fingers as frequently as their index fingers while pointing (Wilkins, 2003).

There is no research available when and how culturally different normative rules for pointing exert their effects on the infants' pointing gestures. Instead empirical evidence shows that index-finger pointing is universal by demonstrating that between the time infants are 8 months and 15 months old, they all begin to point by extending their index fingers (Butterworth & Morisette, 1996; Carpenter et al., 1998). Liskowski, Brown, Callaghan, Takada, and de Vos (2012) showed that by the age of 14 months all infants from the different cultural settings of Papua New Guinea, Rossel Island, Indonesia, Bali, Japan, Kyoto, Peru, Mexico and Canada display pointing behavior.

Another evidence for the universality account in the emergence of pointing gestures comes from the study of Matthews, Behne, Lieven, and Tomasello (2012). They found that the onset of pointing behaviors of 10-month-old infants were not influenced by the training in which their mothers were instructed to engage in pointing activities for 15 minutes per day for a month, but by their prior performance in successfully following an adult's direction of gaze. Matthews and her colleagues (2012) concluded that training by itself is not a sufficient way of evoking pointing behavior from infants. Instead a very rudimentary communicatory skill of

gaze following is necessary, yet perhaps again not sufficient, for infants to begin displaying index-finger pointing gestures. This finding is also likely to be compatible line of evidence with the universality account of the emergence of pointing gestures, while maternal pointing frequency still plays a role in the emergence of gaze following by perhaps not paving the way for the emergence of pointing but paving the way for the frequency of pointing.

Previous research despite converging on a universalistic account on emergence of pointing also suggests that there are crosscultural differences in the frequency of pointing behavior of infants. In a recent monograph, Callaghan, Moll, Rakoczy, Warneken, Liszkowski, Behne, and Tomasello (2011) assessed 12-month-old Peruvian, Canadian and Indian infants' pointing frequency in a joint activity context (namely *decorated room*, also referred as *context of regard* [Liszkowski & Brown, 2007]) in which infants and their mothers explored various interesting objects placed at different locations in a room (and sometimes outdoors) together. Although all the infants were recruited from rural towns in Peru, Canada and India, the mean maternal education levels differed between the infants in these three cultural settings (8.6 years of formal schooling, 15.5 years of formal schooling, and 4.2 of formal schooling, respectively).

The researchers found a significant difference in the number of infant pointing gestures between the samples of Canada and India. Canadian infants more frequently pointed than Indian infants with age controlled. Peruvian infants, although pointed less frequently than Canadian infants and more frequently than Indian infants, did not significantly differ from Canadian or Indian infants in the frequency they displayed pointing gestures. The difference between Canadian and Indian infants was associated with the education levels of the Canadian and the Indian mothers, suggesting that the index-finger pointing acts of infants could be related to maternal education levels. Nevertheless the researchers found that all of

the infants in three cultural settings showed some instances of index-finger pointing at the age of 12 months old despite at different frequencies (Callaghan et al., 2011).

2.2. How do maternal interactive patterns and activities influence index-finger pointing?

Findings of similarity in the age of emergence but differences in frequency of early pointing gestures across cultures require further research to investigate within-cultural differences in the manners and effects of maternal preverbal communication patterns.

Liszkowski and Tomasello (2011) already reported that 12 month olds whose mothers pointed more frequently in *the context of regard* displayed more pointing gestures themselves in the same context (see also Callaghan et al., 2011). Matthews and her colleagues (2012) reported that not the onset of index finger pointing but the frequency with which infants show index finger pointing is influenced by maternal pointing frequency.

The correlation between maternal pointing and infant pointing is usually interpreted to have a direction: mothers who are pointers themselves elicit frequent pointing gestures from their infants as well either through imitation or other communicative mechanisms. Matthews et al. (2012), for example, argue that pointing gestures might be socially shaped since caregivers respond to their infants' reaching behaviors in rewarding ways (i.e. obtaining the desired object for the infant).

Yet more research is needed to confidently claim that the frequency of maternal pointing influences the age of emergence of index-finger pointing. Considering that index-finger pointing is ontogenically preceded by whole-hand pointing (Liszkowski & Tomasello, 2011), whether the transition from whole hand pointing to index finger pointing might be predicted by the maternal pointing frequency, is another intriguing question requiring longitudinal experimental designs, where maternal pointing is also tracked.

However, we have little control over the frequency mothers spontaneously point for their infants. Previous research asserted that whether interactants will engage in more or less

pointing is determined by the activity type that they are participating in (Puccini, Hassemer, Salomo, & Liszkowski, 2010). Accordingly, the intensity of maternal pointing gestures and their possible effects on infants' pointing gestures specifically, and on infants' preverbal communication skills in general could be shaped by the type of activities chosen by the mothers. Thus a mother who is a frequent pointer in one setting might be observed to be displaying fewer acts of index-finger points in another setting.

Puccini et al. (2010) showed that different types of shared activities differentially affect mothers' and infants' gesture production. It was found that in a free play context, called *the context of action*, where the infants and their caregivers were provided with a set of toys both parties utilized proximal deictic gestures such as showing by holding, reaching to, or giving objects. On the other hand, in *the context of regard*, where the same number of stimuli was placed to be distant from the dyads so that infants and their mothers could not reach for them easily, distal deictic gestures such as index-finger pointing were more likely to be employed. The use of different types of gestures by both infants and mothers in two different settings shows that pointing is more prevalent while the communicators are sharing their interest about an object that they cannot directly manipulate.

Moreover not only gestures but speech acts of mothers were also influenced by the type of activity engaged. Mothers used more directives and fewer amount of linguistic references (yet greater amount of verbs referring to actions) in *the context of action* while they provided more comments in *the context of regard* where they also pointed more frequently. It was also in *the context of regard* that caregivers used more linguistic references to direct infants' attention to the objects and to some features of these objects (Puccini et al., 2010). It is perhaps because pointing is underspecified in the sense that contextual or discourse-based cues are needed to make what exactly the speaker is referring to comprehensible.

Puccini et al. (2010) argued that in the context of action, in which both parties manually handled common-ground objects and used more frequent proximal deictic gestures with the presence of more verbs to refer to actions that infants first began to understand how deictics were functioning. Only after understanding how proximal deictic gestures work infants can comprehend their referential function, and begin using distal deictic gestures such as pointing. Thus it is a possibility that proximal deictic gestures pave the way for referential understanding and eventually for production of pointing. However, being able to comprehend the referents of proximal deictic gestures might not be essential for the production of deictic gestures. Indeed infants are observed to display spontaneous pointing gestures before comprehending the pointing gestures of others (Murphy & Messer, 1977; Desrochers et al., 1995), although some research reported that pointing gestures are comprehended before they are produced (Bruner, 1983; Carpenter et al., 1998). However, the existence and the duration of the time lag between pointing production and comprehension abilities of infants might stem from methodological differences among the studies measuring point comprehension skills of young infants.

2.3. Point following studies

Research on pointing following of infants assesses whether infants turn to the direction indicated by the adult's pointing (Butterworth & Itakura, 2000; Carpenter et al., 1998; Morissette, Ricard, & Decarie, 1995; Striano, Stahl, & Cleveland, 2008; Liszkowski & Tomasello, 2011). The basic skill of following the pointings of others to a target is found to be emerging around the age of 12 months. For example the mean age of emergence for the pointing following is reported as 11.7 by Carpenter et al. (1998) in a longitudinal study with 24 infants where the experimenter called the infants' attention to the lateral items. Yet other research (Desrochers, Morissette, & Ricard, 1995; Morissette, Ricard, & Gouin-Dkcarie, 1995) could not find robust evidence for the ability to follow the others' pointing gestures to

the referents until 15 months of age. However, situational factors such as the testing stimuli utilized in the comprehension experiments, the distance of these stimuli to the infant, and whether the experimenter alternates his or her gaze between the stimuli and the infant as s/he performs pointing have not been systematically controlled in previous research, thus yielding relatively different results in the reports of age of emergence of pointing comprehension.

Butterworth and Jarrett (1991) found that infants younger than 12 months cannot follow the other's extended index-finger points to a referent if the referent is outside the infants' visual field, because of a egocentric way of representing spatial information. Social learning accounts argue that infants by this age cannot fully learn how to align themselves with the visual attention of others. Some further argue that small changes in the head turn accompanying pointing acts to referents might not be easily detectible for the infants, thus infants have a difficult time discerning the precise location of the target (Deak, Flom, & Pick, 2000). However, Deak and his colleagues (2000) reported that 12 month old infants could follow the pointing to the target positioned behind them even when there was a distractor object in front of the infants. Yet infants' mean fixations scores for the items positioned behind and in front of them were different ($M = 3.1$, $SD = 3.4$; $M = 7.7$, $SD = 4.7$; respectively). The reason why younger infants cannot robustly follow the pointing gestures of others to referents outside their visual field is not well established, it is a replicated finding that not before infants are 18 months old, they can flexibly and consistently attend to things that others are oriented at if they themselves cannot see these referents in their immediate visual field (Butterworth & Jarrett, 1991).

Moreover following the direction of adult pointing might not necessarily mean that infants understand the communicative intent behind the act of pointing. Rather point following tasks simply inform us about whether infants turn their heads to look at the referent of the pointing act or not. Thus point following performances of infants might not be related

with their own pointing production skills or their later language development. These questions compels a longitudinal perspective on investigating whether simple skill of pointing following plays an important role in pointing production, and consequently in vocabulary development.

2.4. Pointing and Language

Assessing the emergence of production and comprehension of pointing gestures is important since canonical index-finger pointing gestures, as the pioneering researchers in preverbal communication literature have suggested, might pave the way for language development (Camaioni, Caselli, Longobardi, & Volterra, 1991; Desrochers, Morissette, & Ricard, 1995; Iverson & Goldin-Meadow, 2005; Özçalışkan & Goldin-Meadow, 2005; Colonna, Stams, Koster, & Nool, 2010). Brooks and Meltzoff (2008) found that 10 month old infants who predominantly follow the adult gaze to the items positioned infants' left or right and who those pointed spontaneously during the gaze following task at least once produced more words when two years old, with age and maternal education controlled. Harris, Barlow-Brown, & Chasin (1995) reported the onset of pointing (as measured when infants were 9 months old) was correlated with receptive vocabulary of infants when tested at 12 months. Rowe (2000) also reported that 10 months who pointed more frequently had more expressive vocabulary at 14 months.

2.5. Maternal Interactive Input

There is little research available to address the question of how different characteristics of maternal input affect infants' gesture use and comprehension through the latter part of the first year. Liszkowski and Tomasello (2011) recently reported a relation between infants' spontaneous pointing productions and the maternal frequency of pointing; though only for index-finger pointing infants, and not for whole-hand pointers. Further evidence for the positive correlation between infant and maternal pointing was also reported

by Puccini et al. (2010). Matthews et al. (2012) also noted that once infants begin to point their frequency of pointing is related with their mothers' pointing frequency. Yet it is not clear how the maternal pointing frequency exerts influence, if it does, on the age of emergence of pointing production.

Although there is still a handful of studies on the link between maternal gestural input and infants' preverbal communication there have been ample evidence presented for the link between maternal speech and vocabulary development. There are several aspects of maternal speech which influence children's language development, with most of the research focusing on how the quality and the quantity of the linguistic information available to children shape their lexical development (Bloom, 1970; 1973, Gentner, 1982; Choi & Gopnik, 1995; Tardif, 1996; Brown, 1998; Tardif, Gelman, & Xu, 1999; Tardiff & Wellman, 2000). For example it is a well-established finding that low SES children's vocabulary growth in the first three years is slower than high SES age-mates' (Feldman et al., 2000; Morrisset, Barnard, Greenberg, Booth, & Spieker, 1990; Rescorla & Alley, 2001; Hoff, 2003; Noble, Norman, & Farah, 2005). In recent research conducted in Turkey (Baydar, Küntay, Yagmurlu, Aydemir, Çankaya, Gökşen, & Cemalcılar, in press) a gap was found between the receptive vocabulary skills of 3-year-old children of low SES and high SES families, as assessed by a picture-based receptive vocabulary task.

Rowe and Goldin-Meadow (2009a) proposed a mediating role of gestures for the link between SES and language, and they noted SES-related discrepancies across 14-month-old infants' uses of gestures and their vocabulary size as measured by the Peabody Picture Vocabulary Test at the age of 54-months.

Rowe and Goldin-Meadow (2009b) claimed in another study that the more spontaneous gestures the children displayed at 18 months of age, the greater a vocabulary size they had at 42 months. Iverson and Goldin-Meadow (2005) articulate the facilitatory role of

gestures in speech production as well by suggesting that a lexical concept first enters into the infant's precommunicatory repertoire, and then it is transferred into the modality of speech. Infants who make use of various gestures to convey different meanings to their caregivers before they can verbalize these meanings into intelligible sound units might be eliciting greater amount of maternal response, and this in turn might facilitate word learning. For example, an infant pointing at a duck in her vicinity might be eliciting the word *duck* from her mother. After all, as Tomasello and Farrar (1986) argued preverbal communication often takes place in joint attention episodes in which two parties attend the same thing together, and joint attention episodes are strong predictors of language learning (see also Carpenter et al., 1998)

Considering tremendous amount of evidence for the relation between SES and vocabulary, and for the link between infants' gestures and their early vocabulary (Özçalışkan & Goldin-Meadow, 2005; Rowe & Goldin-Meadow, 2009a; Rowe & Goldin-Meadow, 2009b), it is now essential to investigate whether maternal input affects infants' prelinguistic gestural communication as well.

2.6. Specific Aims and Hypotheses

Previous research argued that, leaving out the extreme cases of poverty, maternal education is a reliable proxy for SES and it is strongly associated with parenting qualities, and especially with language development (Bornstein, Hahn, Suwalsky, & Haynes, 2003; Hoff, Laursen, & Tardif, 2002). Hence SES is operationalized as the maternal education in this study, and mothers are grouped as low SES and high SES according to the years of formal schooling they have received.

We investigate the onset and robustness (i.e. frequency) of the communicative act of index-finger pointing, and the point following skills of infants at three time points when the infants are 8 months old, 10 months old, and 12 months old and their language development.

In a nutshell we hypothesize that differences in maternal gestural input, which were expected to be associated with SES, influence infants' pointing production and following skills, and their later language development. However, we do not expect this difference in the socio-cognitive domain to be seen in the fine motor development of infants. We hypothesize that infants' fine motor development is related with mothers' education levels (i.e. we expect mothers with high SES to provide more enriched home environment for their infants permitting them to exercise their fine motor movements) but maternal gestural input is not expected to have an influence on infants' fine motor development. We also do not expect that infants' own index finger pointing behaviors has a relation with their fine motor development.

We specifically hypothesize that the frequency of early child-directed pointing behaviors are responsible for differences in the onset and robustness of pointing behavior of infants, and their later linguistic skills. We investigate whether mothers with high SES more frequently point than mothers with low SES in addition to examining differences within the same SES groups. The infants with educated mothers (high SES infants) and the ones with mothers of relatively less education (low SES infants) are expected to show different patterns in the emergence of point production and point following.

We also explore whether there are associations between the onset (i.e. emergence) and the robustness (i.e. frequency) of pointing behaviors of infants and their consequent language development. Previous studies reported the link between production of pointing gestures at 12 months and speech production rate at 24 months (Camaioni, Caselli, Longobardi, & Volterra, 1991). Butterworth and Morisette (1996) further noted that the younger the infant begins to point, the more frequent gesture production and greater the speech comprehension the infant has at 14 months of age. However, no study has looked for whether pointing following and production at 8 and 10 months olds predict vocabulary comprehension and production at 12 months of age.

Additionally we also investigate whether index finger pointing infants perform better in following the pointing behaviors of others and how infants' performance in point following relate to their early vocabulary comprehension and production.

This is the very first longitudinal study of communicative development during infancy in Turkey, complementing the ECDET study covering the 3-year to 6-year children's development in the areas of language and communication (Baydar et al., in press). It is considered as a pilot for larger scale studies later on. By considering the micro contexts of communication and language development starting from 8 months, we will start establishing what leads to vocabulary competence differences observed at the age of 3-year-olds in infants living in different SES situations (Baydar et al., in press).

CHAPTER 3

METHOD

3.1. Participants

The participants were recruited from Koç University Language and Communication Development (LCD) Laboratory's participant database, local health care centers, or by word of mouth. The participants were subject to additional procedures as they took part in a larger project on infant socio-cognitive development conducted in the LCD lab (See Table A1 in the Appendix A for the list of additional procedures). For this thesis, data were considered from three different time-points of testing, when the infants were 8 months old, 10 months old, and 12 months old.

There were 73 infants who attended the study in one of the three time points: 29 females, 44 males, living in Istanbul and learning Turkish as their native language. Only full

term infants (born after 35 weeks) were included in the study ($M = 38.87$, $SD = 1.7$). Details on sample characteristics are in Table 1.

For the first testing session there were 71 infants: 30 females, 41 males. The mean age of the infants at the first testing session was 259.35 in days ($SD = 15.59$) and 8.52 in months. The age range was between 164 days (5.38 months) and 292 days (9.6 months). No sex differences were found in age ($M_{female} = 260.03$, $SD = 10.26$; $M_{male} = 258.86$, $SD = 18.59$; $t(70) = .31$, $p > .05$). The distribution of the age was negatively skewed and highly peaked (Skewness = 10.75, Kurtosis = 34.97, $p < .05$). There were two infants who were above the age limit, and one below the age limit decided for the purposes of the first testing session (i.e. 8 months of age). When these three subjects were excluded the distribution of the age was normal (Skewness = .54, Kurtosis = .12, $p > .05$; $M_{age} = 259.96$, $SD = 9.56$). Hence these three subjects were not included in any of the analyses in this thesis (yielding 29 females and 39 males).

Out of 68 infants at the first testing session there were 32 infants (14 females, 18 males) whose mothers had at least university degree education (i.e. 16 years of education). There were four infants (one female, three males) whose mothers had a two-year university degree (i.e. “önlisans/açıköğretim”; 14 years of education). There was one infant (male) whose mother dropped out in her first year of the university education, one infant (female) whose mother dropped out of high school and another one (male) whose mother dropped out of primary school. There were seven infants (two females, five males) whose mothers had high school degree (i.e. 12 years). There were 24 infants (10 females, 12 males) whose mothers had secondary education at most (i.e. 8 years). Table 1 indicates the number of female and male infants whose mothers had university degree education and above and secondary education and below (These two groups of education levels were further categorized as high socio-economic condition and low socio-economic condition).

23 infants out of 71 dropped out after the first time point of testing (See Appendix B for the summary of analyses indicating that dropped-out infants did not significantly differ than the remaining in terms of certain demographic variables [e.g. age, sex, SES]). There were 48 infants remaining for the second time point of testing and two male infants joined the study at this point. Thus there were 50 infants in total for the second testing session: 18 females, 32 males. The mean age of the infants at the second testing session was 326.48 in days ($SD = 10.11$) and 10.71 in months. The age range was between 309 in days (10.15 months) and 364 days (11.95 months). No sex differences were found in age ($M_{female} = 323.28$, $SD = 8.34$; $M_{male} = 328.28$, $SD = 10.68$; $t(48) = 1.71$, $p > .05$). The distribution of the age was negatively skewed and slightly peaked (Skewness = 2.8, Kurtosis = 4.01, $p < .05$). There was one infant who was above the age limit decided for the purposes of the second testing session (i.e. 10 months of age). When this subject was excluded the distribution of the age was normal (Skewness = .13, Kurtosis = -.5, $p > .05$; $M_{age} = 325.71$, $SD = 8.62$). Hence this subject was not included in any of the analyses in this thesis (yielding 18 females and 31 males).

Out of 49 infants at the second testing session there were 23 infants (10 females, 13 males) whose mothers had at least university degree education. There were three infants (all males) whose mothers had two-year university degree. There was one infant (male) whose mother dropped out in her first year of the university education. There were three infants (one female, two males) whose mothers had high school degree. There were 19 infants (7 females, 12 males) whose mothers had secondary education at most.

Three more infants out of 50 dropped out after the second time point of testing. There were 47 infants remaining for the third time point of testing: 17 females, 30 males. The mean age of the infants at the second testing session was 383.19 in days ($SD = 9.03$) and 12.58 in months. The age range was between 363 days (11.92 months) and 400 days (13.14) months). No sex differences were found in age ($M_{female} = 380.94$, $SD = 9.31$; $M_{male} = 384.47$, $SD = 8.77$;

$t(45) = .92, p > .05$). The distribution of the age was normal (Skewness = .14, Kurtosis = .97, $p > .05$).

Out of 47 infants at the third testing session there were 26 infants (10 females, 16 males) whose mothers had at least university degree education. There were two infants (all males) whose mothers had two-year university degree. There was one infant (male) whose mother dropped out in her first year of the university education. There were two infants (both males) whose mothers had high school degree. There were 18 infants (7 females, 11 males) whose mothers had secondary education at most.

Table 1. *Longitudinal sample characteristics*

Time Points	N	Sex (N)	Age in Days	Mother Education in Years	
			M (SD)	Low (Sex)	High (Sex)
8 Months	68	F (29)	259.96	10 (F)	14 (F)
		M (39)	(9.56)	12 (M)	18 (M)
10 Months	49	F (18)	325.71	7 (F)	10 (F)
		M (31)	(8.62)	12 (M)	13 (M)
12 Months	47	F (17)	383.19	7 (F)	10 (F)
		M (30)	(9.03)	11 (M)	16 (M)

Note. Values for “Age in Days” show the mean age for each time point with standard deviations in parentheses.

3.2. Procedure

The testing was carried out by one of the two graduate students in developmental psychology in Koç University (Nazlı Altınok or Özge Savaş) in the LCD Lab. Except for the *Decorated Room* procedure, all the tasks were carried out in the same testing room. The infants first received *Simple Point Following*, and then *Mullen Scales of Early Learning* in all three time points. *MacArthur-Bates Communicative Development Inventories (TİGE)* was administered in the second and the third time points (i.e. when the infants were 10 and 12 months old). See Appendix A, Table A1 for the counterbalanced list of the tasks carried out in this thesis and for the tasks conducted in the larger research study.

3.3. Tasks

3.3.1. Decorated Room (Context of Regard)

2.3.1.1. Materials and Setup

In order to naturally elicit pointing behavior from infants and their mothers various stimuli were placed on the walls following the standard “context of regard” setup (Liszkowski & Brown, 2007). The items used for the purposes of decoration were the same 19 items that were used by Liszkowski and Brown (2007). A Turkish coffee cup was added as a 20th item. The items were one foldable clown-face lantern, a large butterfly, a clownbell doll, a dangling key ring, a silver disco mirror ball, a feather boa, a Hawaiian flower lei, a red bike light which flashes when it is set up, pair of bike reflectors that are tied together, a spiral pinwheel, a doll, paper flowers, a ball, a balloon, and four posters of various animals. All the objects were placed in such a way to create the atmosphere of an exhibition for the participants. The exhibition room was 8m² in total. Stimuli were kept out of reach with rope-barriers placed 40 cms away from the wall. They were used to naturally increase the distance of the items to the

dyads and to reduce mothers' and infants' tendency to play with or touch the items on the walls.

Because one side of the room contained a large two-way mirror, a black curtain was used to cover it. All the items were distributed at different heights, and each wall had five items except the one with the black curtain, which had four items.

Four cameras were set up in the corners to record infants and their mothers as they walk around in the decorated room. The cameras were positioned in a way not to leave a blind spot to record the actions of infants and their mothers as they moved around. Each camera was set up to capture the extended hand movements of infants and mothers in case they walked towards to the walls (see Appendix C for the schematic drawing of the decorated room displaying the items placed on its walls).

3.3.1.2. Procedure

Mothers were invited into the decorated room and they were instructed to carry their infants on their hips (to permit the dyads to engage in eye-contact) as they moved around in the room for five minutes. The mothers were specifically instructed not to touch any of the items.

3.3.1.3. Data Coding

All the data were coded using ELAN, software developed by Max Planck Institute for Psycholinguistics, that allows time-locked coding of the video recordings. Gestures were the main interest of coding. Gestures produced by both mothers and their infants were coded as whole hand pointing or index finger pointing. If the mother's or the infant's arm was explicitly extended toward an item or toward a location and if the mother or the infant was looking towards that item or that location even for a brief time as she extended her arm these behaviors were coded as pointings.

If the index finger was distinctly extended from other fingers while pointing this was coded as index finger pointing, if not this was coded as whole hand pointing. If an infant distinctively leaned towards an item this behavior was interpreted as “reach”, not a whole-hand point, and was not coded. We also treated loose hand movements with care, and did not code them as pointings.

If the mother or the infant directed her pointing to another item without releasing her extended arm we coded this as another point since the referent of the pointing behavior was now different. If she released her arm and made it explicit that she was now engaging in another pointing behavior by re-extending her arm in order to point to the same item or another item we coded this as a different point than the prior pointing. One of the experimenters coded for infants’ and their mothers’ gestures from the video recordings. A naïve coder coded 20% of the data, yielding the coding of seven randomly chosen dyads. The inter-rater reliability between coders for identifying infants’ gestures was 87% (Cohen’s Kappa = .78) and for identifying mothers’ gestures 95% (Cohen’s Kappa = .72). For infants’ index finger pointing behaviors the raters showed a 80.43% agreement and for infants’ whole hand pointings the agreement was 82.4%. For mothers’ index finger pointings the raters showed a 95.38% agreement, and for mothers’ whole hand pointings the raters showed an 87.5% agreement.

3.3.2. Simple Point Following

This experiment was adapted from Mundy (2003).

3.3.2.1. Materials

Four different animal stickers (picturing an elephant, a lion, a giraffe, and a hippopotamus) with the same size of 31 cm x 31 cm were placed on green, yellow, orange and blue 50 cm x 70 cm posters. Two posters were placed on the wall at 60 degrees from the infant’s midline to the infant’s left and right. These two posters were within the infant’s view.

The remaining two posters were placed on the wall at 150 degrees from the infant's midline to the infant's left behind and right behind. These two posters were out of the infant's view (See Appendix D for the posters' positions).

3.3.2.2. Design and Procedure

The infants sat on their mother's lap facing the testing table and opposite to the experimenter. The experimenter sat slightly to the side of the table so that the video recording could clearly capture the infants' bodily orientation. The experimenter also made sure that she remained at the infant's eye level during the trials.

After making sure that the infant was engaged with the experimenter the trials began. The experimenter first attracted the infant's attention to her face (i.e. by touching the infant, and then touching her own nose). After getting the infant's attention the experimenter looked at only one poster at a time by orienting her entire torso towards it, she then pointed to the target poster. At the same time while pointing the experimenter said: "(Infant's name) (4 seconds of pause) Oh that's nice!" / "Ayşe (four second of pause), Aaa ne güzel". The experimenter paused for four seconds after uttering the infant's name; hence each pointing sequence took a minimum of six seconds approximately. After each pointing trial, the experimenter uttered a sentence related to the poster (e.g., "There's Mickey, did you see Mickey?") for confirming that the infant turned and saw the poster or for further engaging the infant with the poster if s/he did not turn. For the behind trials, the experimenter leaned slightly forward and to the left or right of the infant as if s/he saw something interesting directly behind the infant. However, her pointing finger was always at least 0.6 m in front of the infant to make sure that infant could reliably perceive that pointing finger was referring to an outside entity.

Another important point was that the experimenter did not look back at the infant until she was done with the pointing trial in order not to bias the task towards gaze-following.

The four second pause between the enunciations was to make sure that developmentally immature infants would have enough time to process the information (Mundy, 2003).

The four pointing trials were carried out in the following sequence: to the E's Left, Left-Behind, Right, Right-Behind.

3.3.2.3. Data coding

One of the experimenters and a naïve coder coded for infant's direction of gaze and direction of head for the four pointing trials from the video recordings. The infants received a qualitative score of "correct look" if they turned their eyes or their heads indicating that they looked to the pointed target and beyond the end of the E's index finger. For behind-pointing trials, the infants' behaviors were interpreted as "correct look" only when they turned their head more than 90 degrees towards the target. The infants received a qualitative score of "no-look" if they did not turn their eyes or their heads towards the direction of the pointed target but looked somewhere else in the testing room (e.g. ceiling, video camera recorder). They received "incorrect look" score if they looked not at the target poster but any other poster placed on the walls for the purposes of this task (i.e. the E pointed to the poster that was right of the infant but the infant looked at the poster which was right behind her). We also coded for trials in which there was an experimenter error (e.g. the E shifted her gaze between the target and the infant while pointing), and a mother error (e.g. the mother pointed to the target poster while the experimenter was pointing for the infant, the mother adjusted the body position of her infant for him to better see right or left behind items). We excluded the trials in which the infants were uncooperative in addition to trials where there were errors (either stemming from experimenter or mother) while analyzing the data.

A naïve coder coded 37 randomly chosen infants from the first time point of testing, 29 randomly chosen infants from the second time point of testing, and 22 randomly chosen infants from the third time point of testing, amounting to 59% of the data. We obtained a high

inter-rater reliability (Cohen's Kappa= .89). For correct look behaviors the raters agreed on 94% of the data. For incorrect look behaviors the agreement was 78% and for no-look behaviors the agreement was 88%.

3.3.3. Mullen Scales of Early Learning (MSEL)

We only carried out the fine motor subscale of MSEL (Mullen, 1995) at the three time-points. The fine motor subscale of the MSEL required infants to manipulate objects both bilaterally and unilaterally (See Appendix E to review the items on the fine motor subscale of MSEL). Bilateral manipulation required such fine motor abilities as turning pages in a book, unscrewing and/or screwing a nut and bolt, stringing beads, folding, and cutting. Unilateral manipulation required such fine motor abilities as stacking blocks, putting pennies in horizontal or vertical slots, imitating block models, and drawing (Mullen, 1995). In this subscale there were 30 items in total. Some example items for the target age-range required infants grasping a wooden stick and a wooden cube, and receiving plastic rings with finger tips. The stopping rule for the MSEL finer motor subscale required the experimenter continue carrying out the assessment until the infant provided three consecutive wrong answers or unless s/he provided no answers repeatedly for three consecutive items.

3.3.3.1. Scoring

If the infant provided a correct answer the experimenter scored it as 1, if there was no answer or if there was a wrong answer the experimenter scored it as 0. The coding was done by the experimenter during the testing. The maximum possible score was 12 and the minimum score was 0.

3.3.4. Turkish Communicative Development Inventory (TİGE)

TİGE is an adapted version of the MacArthur-Bates Communicative Development Inventory (CDI) to the Turkish culture, early language, and language (Acarlar, Aksu-Koc, Küntay, Maviş, Sofu, Topbaş, & Turan, 2009). It is a parent report measure of early linguistic

and communicative abilities originally developed by Fenson, Marchman, Thal, Dale, Reznick and Bates (2007). There are two versions: TİGE I for the ages between 8 and 16 months and TİGE II for the ages between 16 and 30 months. TİGE I was administered only when the infants were 10-months-old, and 12-months-old as a parent-report checklist to assess the number of words the child was able to say and/or understand and also to investigate his/her early communicative repertoire. See Appendix F to review the original items in TİGE I.

TİGE I had two subsections: One assessing the comprehension and expression of early words, and the other assessing the actions performed and the gestures produced by young children. The first subsection measured whether the child could comprehend some phrases that were commonly used in daily mother-infant interactions (e.g. “Are you hungry?”, “Give it to me”), and whether the child could comprehend and/or express some vocabulary including nouns, pronouns, verbs, adjectives and adverbs. We counted all the items the infants were reported as comprehending and producing to calculate infants’ scores in the first subsection.

The second subsection included questions asking whether the child participated in playful activities (e.g. singing, dancing), whether the child performed certain actions with objects (e.g. eating with a spoon or fork, wearing a hat), whether the child gestured (e.g. pointing by extending his/her index finger or his arm, nods), whether the child was imitating an adult behavior (e.g. pretends to read), whether the child was behaving like a parent (e.g. feeds a doll), and whether the child was engaging in object-substitution (e.g. using a banana as if it were a phone). We again counted all the items the infants were reported as performing to calculate infants’ scores in the second subsection.

CHAPTER 4

RESULTS

4.1. Overview of Results

In this section I will summarize the analyses on the pointing data elicited in the decorated room context, in addition to the simple point following data and MSEL in three time points. I will further summarize the analyses on maternal reports of language development.

4.2. Decorated Room Analyses

There were 35 infants who participated at each time point of testing: 15 females, 20 males. Out of 35 infants 20 were from high SES (9 females, 11 males) and 15 from low SES families (6 females, 9 males).

4.2.1. Infants

4.2.1.1. Infant Index Finger Pointings at 8 months, 10 months and 12 months

At the first time point of testing (i.e. 8 months), only 7 infants out of 35 (20%) showed index finger pointing (See Table 1 for the demographic characteristics of the pointer infants). The mean number of infants' index finger pointings was .83 ($SD = 3.55$). One infant (male, low SES) pointed with his index finger 21 times. The maximum number of pointing was 21, and the minimum was 0. The distribution of the number of index finger pointings was not normal (Skewness = 14.33, Kurtosis = 42.69, $p < .05$). Mann-Whitney U test revealed that high SES and low SES infants did not differ from each other in the number of index finger pointings at 8 months ($U = 147$, $p > .05$). Mann-Whitney U test also revealed that females and males did not differ from each other in the number of index finger pointings at 8 months ($U =$

148.5, $p > .05$). There were no SES or sex related differences in the onset of index finger pointing at 8 months (i.e. whether infants showed index pointing or not) ($U = 150$, $p > .05$; $U = 150$, $p > .05$, respectively)

When we excluded the infant with 21 index finger pointings, the maximum number of pointing was 2. Data were again not normal (Skewness = 5.83, Kurtosis = 6.19, $p < .05$). The mean number of index finger pointings was .24 ($SD = .55$). Mann-Whitney U tests revealed that neither SES nor sex made a difference in the frequency of index finger pointing ($U = 133$, $p > .05$; $U = 136.5$, $p > .05$, respectively). SES or sex further did not make a difference for the infants who displayed one or more index finger pointings ($N = 7$) ($U = 3$, $p > .05$; $U = 4.5$, $p > .05$, respectively). Even when we removed the outlier with 21 index finger pointings, we could not find any SES or sex effects ($N = 6$) ($U = 3$, $p > .05$; $U = 4.5$, $p > .05$, respectively).

At the second time point of testing (i.e. 10 months), 14 infants out of 35 (40%) showed index finger pointing. The mean number of infants' index finger pointings was 2.42 ($SD = 5.7$) with a range of 0-28 (Skewness = 8.55, Kurtosis = 16.35, $p < .05$). Mann-Whitney U test revealed that high SES and low SES infants did not differ from each other in the number of index finger pointings at 10 months ($U = 148$, $p > .05$). Mann-Whitney U test also revealed that females and males did not differ from each other in the number of index finger pointings at 10 months ($U = 130.5$, $p > .05$). SES or sex further did not make a difference in the number of pointing for the infants who displayed index finger pointing ($N = 14$) ($U = 22$, $p > .05$; $U = 20.5$, $p > .05$, respectively). There were no SES or sex related differences in the onset of index finger pointing at 10 months (i.e. whether infants showed index pointing or not) ($U = 150$, $p > .05$; $U = 132.5$, $p > .05$, respectively). We compared 28 infants who did not display any index finger pointings at 8 months with those seven infants who displayed index pointing at 8 months in terms of the frequency of index finger pointing frequency at 10 months. Mann

Whitney U test with a factor of index finger pointing at 8 months (with two levels of the display of index finger pointing or no-display of index finger pointing) showed that the infants who displayed index finger pointing at 8 months showed more frequent index pointing at 10 months than the ones who did not display any index pointing at 8 months. The mean rank of index finger pointing at 10 months for the infants who showed index finger pointing at 8 months was 25.21 and the mean rank for the infants who did not show any index pointing at 8 months was 16.2 ($U = 47.5$, $p = .01$, 2-tailed).

26 infants out of 35 (74.3%) showed index finger pointing at 12 months. The mean number of infants' index finger pointings was 5.11 ($SD = 5.97$) with a range of 0-22 (Skewness = 3.67, Kurtosis = 1.64, $p < .05$). Mann-Whitney U test revealed that high SES and low SES infants did not differ from each other in the number of index finger pointings at 12 months ($U = 144.5$, $p > .05$). Mann-Whitney U test also revealed that females and males did not differ from each other in the number of index finger pointings at 12 months ($U = 120.5$, $p > .05$). SES or sex further did not make a difference for only infants who displayed index finger pointing ($N = 26$) ($U = 74.5$, $p > .05$; $U = 70.5$, $p > .05$, respectively). There were no SES or sex related differences in the onset of index finger pointing at 12 months (i.e. whether infants showed index pointing or not) ($U = 135$, $p > .05$; $U = 130$, $p > .05$, respectively). However, 14 infants who displayed index finger pointing at 10 months were the ones who more frequently displayed index finger pointing at 12 months as Mann Whitney U test with a factor of index finger pointing at 10 months (with two levels of the display of index finger pointing or no-display of index finger pointing) showed. Yet this effect was only marginally significant ($U = 98.5$, $p = .05$, 1-tailed). Mean rank of index finger pointing at 12 months for the infants who showed index pointing at 10 months was 21.46 and mean rank for the infants who did not show any index pointing at 10 months was 15.69.

There were nine infants who did not show any index finger pointing at 12 months (five females [2 low SES, 3 high SES], four males [1 low SES, 3 high SES]). Out of nine, two of them produced index finger pointings in the decorated room context in the previous two time points, when they were 8 or 10 months. We had seven infants (five females [2 low SES, 3 high SES], and two males [both high SES]) who did not display any index finger pointings in any of the time points. (Yet please note that we also investigated the number of index finger or whole hand pointings infants displayed during the task of *Point Following* [PF], two of the infants out of seven who did not produce any index finger pointings in the decorated room context pointed with their whole hands at 10 months six times, and three times at 12 months in the PF experiment. Hence we had only five infants who did not display any pointing during the whole study.)

There were four infants at 12 months who did not point either with their hands or their index fingers (two females [1 low SES, 1 high SES], two males [2 high SES]). They all expect one (female, high SES) produced at least one point in the previous time points.

Table 2 presents the number of infants who pointed either with their index fingers or hands. Table 3 presents the frequency of each pointing behavior, according to SES and sex.

Table 2. *Number of infants who pointed with their index fingers only, whole hands only, and both with their whole hands and index fingers interchangeably in the decorated room at 8 months, 10 months and 12 months*

Time Points	Pointing Shape	High SES			Low SES			Total
		Female	Male	Total	Female	Male	Total	
8 Months	Index Finger	0	1	1	0	1	1	2
	Whole Hand	3	5	8	2	2	4	12
	Both	1	2	3	2	0	2	5
	Total	4	8	12	4	4	7	19
10 Months	Index Finger	0	1	1	0	2	2	3
	Whole Hand	3	3	6	3	2	5	11
	Both	3	4	7	2	2	4	11
	Total	6	8	14	5	6	11	25
12 Months	Index Finger	2	1	3	0	1	1	4
	Whole Hand	2	1	3	1	1	2	5
	Both	4	7	11	4	7	11	22
	Total	8	9	17	5	9	14	31

Table 3. Mean number of index finger and whole hand points of infants in the decorated room at 8 months, 10 months and 12 months

Time Points	Pointing	High SES			Low SES			Total
	Shape	Female	Male	Total	Female	Male	Total	
8 Months	Index Finger	.11 (.02)	.36 (.07)	.23 (.04)	.5 (.1)	2.33 (.46)	1.71 (.34)	.82 (.16)
	Whole Hand	1.11 (.22)	1.9 (.38)	1.85 (.37)	1.5 (.3)	1.22 (.24)	.85 (.17)	1.45 (.29)
	Total	1.22 (.24)	2.27 (.45)	2.09 (.41)	2 (.4)	3.5 (.71)	2.57 (.51)	2.28 (.45)
10 Months	Index Finger	1.11 (.22)	3.9 (.78)	2.52 (.5)	.83 (.16)	3 (.6)	2.28 (.46)	2.42 (.48)
	Whole Hand	6.44 (1.28)	3.45 (.71)	4.61 (.93)	2.16 (.43)	1.44 (.28)	1.78 (.35)	3.48 (.7)
	Total	7.55 (1.51)	7.36 (1.49)	7.14 (1.44)	3 (.6)	4.44 (.89)	4.07 (.81)	5.91 (1.19)
12 Months	Index Finger	3.11 (.85)	7.45 (1.05)	5.38 (.91)	4.5 (.4)	4.55 (1.68)	4.71 (1.25)	5.11 (1.05)
	Whole Hand	6.77 (1.12)	3.18 (1.29)	4.8 (1.16)	5 (1.06)	6.33 (.66)	5.85 (.87)	5.22 (1.05)
	Total	9.88 (1.97)	10.72 (2.34)	10.76 (2.08)	9.5 (1.46)	10.88 (2.35)	10.75 (2.12)	10.74 (2.1)

Note. Values in parentheses indicate the mean number of pointings per minute.

4.2.1.2. Change in Infant Pointings over Time

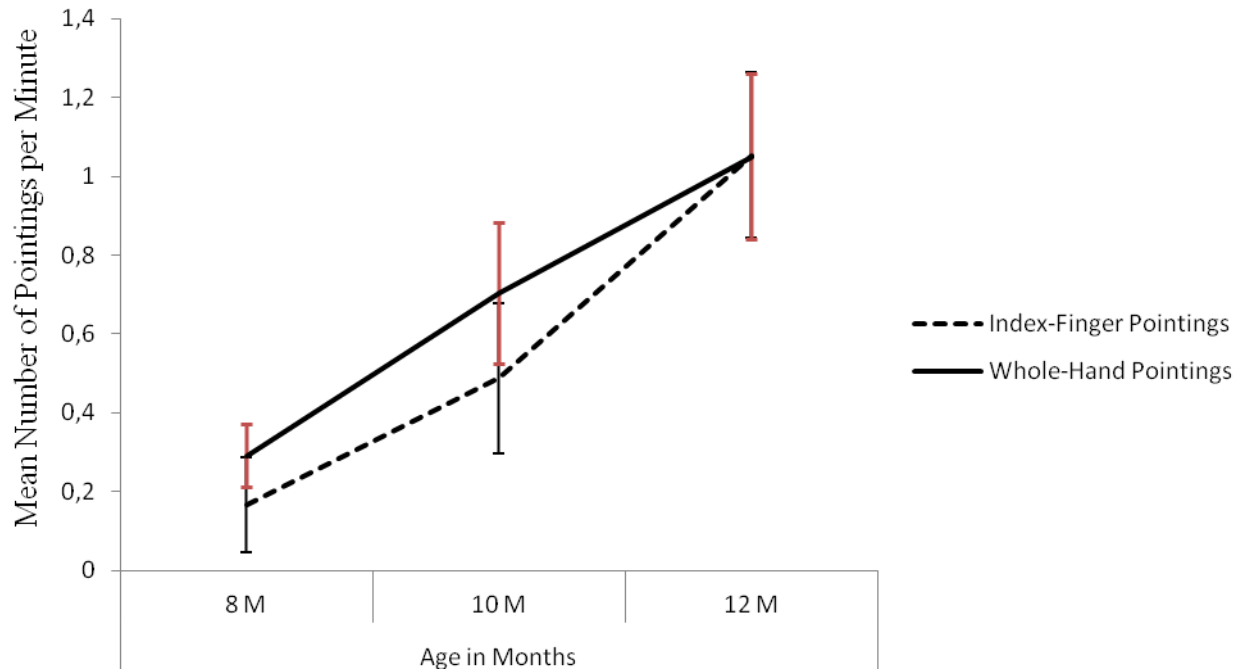


Figure 1. Mean number of index finger pointings and whole hand pointings of infants per minute according to age

As seen in Figure 1, the number of index finger pointings in the decorated room sessions significantly increased over developmental time as Friedman's ANOVA revealed ($\chi^2(2) = 28.52, df = 2, N = 35, p < .001$). Wilcoxon signed-rank tests were used to follow up this significant change. A Bonferroni correction was applied; hence all effects were reported at a .0167 level of significance. The median numbers of index finger pointings for infants at 8 months, at 10 months, and at 12 months were 0 (0-0), 0 (0-2), and 3 (0-9), respectively. There were no significant differences between index finger pointing frequencies of infants at 8 months and 10 months ($Z = -2.24, p = .02$). However, there was a significant difference between index finger pointing frequencies of infants at 8 months and 12 months ($Z = -3.95, p$

< .001) and between index finger pointing frequencies at 10 months and 12 months ($Z = -2.72, p = .006$).

4.2.1.3. Infant Whole Hand Pointings at 8 months, 10 months and 12 months

At the first time point of testing (i.e. 8 months) 17 infants out of 35 (48.57%) showed whole hand pointing (see Table 1 for the demographic characteristics of pointer infants). The mean number of infants' whole hand pointings was 1.46 ($SD = 2.59$) with a range of 0-12 (Skewness = 6.83, Kurtosis = 10.62, $p < .05$). (Five of 17 whole hand pointers were also pointing with their index fingers at 8 months already). Mann-Whitney U test revealed that high SES and low SES infants did not differ from each other in the number of whole hand pointings at 8 months ($U = 149.5, p = .98$). Mann-Whitney U test also revealed that females and males did not differ from each other in the number of whole hand pointings at 8 months ($U = 139, p = .73$). SES or sex further did not make a difference for the infants who displayed one or more whole hand points ($N = 17$) ($U = 30.5, p = .66$; $U = 34.5, p = .88$, respectively).

At the second time point of testing (i.e. 10 months) 22 infants out of 35 (62.85%) showed whole hand pointing (Only 11 of 22 whole hand pointers were also pointing with their index fingers at 10 months already). The mean number of infants' whole hand pointings was 3.48 ($SD = 5.41$) with a range of 0-21 (Skewness = 5.24, Kurtosis = 5.02, $p < .05$). Mann-Whitney U test revealed that high SES and low SES infants did not differ from each other in the number of whole hand pointings at 10 months ($U = 117.5, p > .05$). Mann-Whitney U test also revealed that females and males did not differ from each other in the number of whole hand pointings at 10 months ($U = 112, p > .05$). High SES whole hand pointers pointed marginally more frequently than their low SES agemates ($U = 33.5, N = 17, p = .09$). Mean rank of whole hand pointing for low SES pointers was 8.72 whereas the mean rank was 13.42 for high SES pointers. Whole hand pointer females and males did not differ from each other in the number whole hand points ($U = 50, N = 17, p = .51$).

At the third time point of testing (i.e. 12 months) 27 infants out of 35 (77.14%) showed whole hand pointing (22 of 27 whole hand pointers were also pointing with their index fingers at 12 months already). The mean number of infants' whole hand pointings was 6.25 ($SD = 6.29$) with a range of 0-24 (Skewness = 3.94, Kurtosis = 2.54, $p < .05$). Mann-Whitney U test revealed that high SES and low SES infants did not differ from each other in the number of whole hand pointings at 12 months ($U = 127$, $p > .05$). Mann-Whitney U test also revealed that females and males did not differ from each other in the number of whole hand pointings at 12 months ($U = 148$, $p > .05$). SES or sex further did not make a difference for the infants who displayed one or more whole hand points ($N = 27$) ($U = 89$, $p > .05$; $U = 76$, $p > .05$, respectively).

We assessed whether the display of whole hand pointing at 8 months (with two levels of whole hand pointing or not) had an effect on the number of index finger pointing at 10 months. Yet we could not find a significant effect of whole hand pointing behavior on the frequency of index finger pointing at 10 months or at 12 months ($U = 143$, $p > .05$; $U = 140.5$, $p > .05$, respectively). There was also no effect of the display of whole hand pointing behavior at 10 months on the frequency of index finger pointing at 12 months ($U = 117.5$, $p > .05$).

We further carried out binary logistic regressions to assess whether the frequency of whole hand pointing at 8 months predicts index finger pointing onset at 10 months and at 12 months. There was no predictive effect of whole hand pointing frequency at 8 months on index pointing onset at 10 months (Wald's statistic = .23, $df = 1$, $p = .62$, $B = .06$, $\text{Exp}(B) = 1.06$, $SE = .13$) or at 12 months (Wald's statistic = .88, $df = 1$, $p = .34$, $B = .34$, $\text{Exp}(B) = 1.41$, $SE = .36$). There was also no predictive effect of whole hand pointing frequency at 10 months on index pointing onset at 12 months (Wald's statistic = .01, $df = 1$, $p = .91$, $B = .00$, $\text{Exp}(B) = 1.00$, $SE = .08$).

4.2.1.4. Change in Infant Whole Hand Pointings over Time

To assess whether the number of whole finger pointings significantly changed over time we carried out Friedman's ANOVA. It was found that whole hand pointings of infants increased over time ($\chi^2(2) = 15.45, df = 2, N = 35, p < .001$). Wilcoxon signed-rank tests were used as follow-up tests for the change in the number of whole hand pointings. A Bonferroni correction was applied; hence all effects were reported at a .0167 level of significance. The median numbers of whole hand pointings for infants at 8 months, 10 months, and 12 months were 0 (0-2), 1 (0-5), and 3 (1-7), respectively. There were no significant differences between whole hand pointing behaviors of infants at 8 months and 10 months ($Z = -2.14, p = .032$) and between whole hand pointing behaviors of infants at 10 months and 12 months ($Z = -1.91, p = .055$). However, there was a significant difference between whole hand pointing behaviors of infants at 8 months and 12 months ($Z = -3.55, p < .001$). As seen in Figure 1 infants pointed more with their whole hands when they were 12 months in comparison to when they were 8 months old.

4.2.1.5. Total Change: Is the increase in the frequency of infants' index finger pointings greater than the increase in their whole hand pointings across developing age?

We ran a 2x2 ANOVA with a within subject factor of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of pointing (with two levels of index finger pointing and whole hand pointing) to assess whether index finger pointers' pointings increased to a greater degree by time. We could not find a significant time x hand shape interaction ($F(2, 68) = .17, p > .05, \eta^2 = .005$). The developmental increase in pointing behavior was the same for both hand shapes. The number of pointings, whether they were index fingers or whole hands, increased by the time the infants were 12 months old. (These results should be dealt with care, though, since our data violated the normality assumptions of repeated measures statistics.)

Please see Appendix G for more detailed analyses assessing whether the frequency of index finger pointing behaviors of infants were different from their whole hand pointings in each time point.

4.2.1.6. Correlations between Infant Pointings

We carried out a spearman's rank order correlation to determine the relations between infant pointings at each time point. Pointing behaviors of infants, independent of them being whole hand pointings or index finger pointings, at 8 months and at 10 months were strongly correlated ($r_s(35) = .45, p = .003$) and pointings of infants at 10 months and at 12 months were further strongly correlated ($r_s(35) = .54, p = .00$). Yet the correlation between infants' pointings at 8 months and at 12 months did not reach significance ($r_s(35) = .21, p = .107$). All p values reported here and below are one-tailed.

When we investigated infants' pointing behaviors separately according to their shapes we found significant relations between index finger pointings of infants between the time points (see Table 3 for the summary of inter-correlations between infant pointings across time points). For 8 months and 10 months, and for 10 months and 12 months there were significant correlations of index finger pointing behaviors ($r_s(35) = .406, p = .008$; $r_s(35) = .29, p = .04$, respectively). We further found a marginally significant relation between index finger pointings of infants at 8 months and at 12 months ($r_s(35) = .26, p = .06$).

Infants' whole hand pointings at 8 months and at 12 months, and at 10 months and 12 months were significantly correlated ($r_s(35) = .403, p = .008$; $r_s(35) = .34, p = .02$, respectively). The correlation between infants' whole hand pointings at 8 months and at 10 months failed to reach significance ($r_s(35) = .24, p = .08$). There were no correlations between index finger pointings and whole hand pointings of infants in any of the time points.

Table 4. *Summary of inter-correlations for index-finger and whole-hand pointings of infants at 8 months, 10 months and 12 months*

Variable	1	2	3	4	5	6
1. Index-Finger Pointings (8Ms)	-	.13	.4**	.25	.26	-.03
2. Whole-Hand Pointings (8Ms)	.13	-	.05	.24	.02	.4**
3. Index-Finger Pointings (10Ms)	.4**	.05	-	.22	.29*	.12
4. Whole-Hand Pointings (10Ms)	.25	.24	.22	-	.26	.34*
5. Index-Finger Pointings (12Ms)	.26	.02	.29*	.26	-	.15
6. Whole-Hand Pointings (12Ms)	-.03	.4**	.12	.34*	.15	-

Note. * $p < .05$ (1-tailed), ** $p < .01$ (1-tailed), $N = 35$

4.2.2. Maternal Pointings at 8 months, 10 months and 12 months

32 mothers pointed at least once during all time points, except one mother (high SES) at the first time point of testing, one mother (low SES) at the second time point of testing and one mother (low SES) at the third time point of testing. 21 mothers at the first time point of testing, 12 mothers at the second time point, and 18 mothers at the third point of testing pointed with their whole hands in addition to pointing with their index fingers.

The mean number of maternal pointing in the first time of testing was 14.71 ($SD = 8.57$) with a range of 0 to 36 (Skewness = .79, Kurtosis = -.27, $p > .05$). The mean number of maternal index finger pointing in the first time of testing was 14.11 ($SD = 8.34$) with the range of 0 to 35 (Skewness = .79, Kurtosis = -.27, $p > .05$). The mean number of maternal whole hand pointing in the first time of testing was .6 ($SD = 1.14$) with the range of 0 to 5.

The data for the maternal whole hand pointing was negatively skewed (Skewness = 6.07, $p < .05$; Kurtosis = -.27, $p > .05$).

The mean number of maternal pointing (either with index finger or hand) in the second time of testing was 17.71 ($SD = 10.83$) with the range of 0 to 42 (Skewness = 1.5, Kurtosis = -.51, $p > .05$). The mean number of maternal index finger pointing in the second time of testing was 16.83 ($SD = 10.72$) with the range of 0 to 39 (Skewness = 1.14, Kurtosis = -.92, $p > .05$). The mean number of maternal whole hand pointing in the second time of testing was .34 ($SD = .9$) with the range of 0 to 4. The data for the maternal whole hand pointing was negatively skewed and highly peaked (Skewness = 7.59, Kurtosis = 11.68, $p < .05$).

The mean number of maternal pointing in the third time of testing was 16.51 ($SD = 10.82$) with the range of 0 to 47. The data were slightly skewed (Skewness = 2.85, $p < .05$; Kurtosis = 1.29, $p > .05$). The mean number of maternal index finger pointing in the third time of testing was 16 ($SD = 10.82$) with the range of 0 to 47. It was also slightly negatively skewed (Skewness = 3.11, $p < .05$; Kurtosis = 1.59, $p > .05$). The mean number of maternal whole hand pointing in the third time of testing was .51 ($SD = .88$) with the range of 0 to 3. The data for the maternal whole hand pointing was negatively skewed and slightly peaked (Skewness = 4.27, Kurtosis = 2.55, $p < .05$).

Table 5. *Mean index finger and whole hand pointing behaviors of mothers in the decorated room context when their infants were 8 months, 10 months and 12 months*

Time Points	Pointing Shape	High SES	Low SES	Total
8 Months	Index Finger	12.8 (2.56)	15.86 (3.17)	14.33 (2.86)
	Whole Hand	.65 (.13)	.53 (.1)	.59 (.11)
	Total	13.45 (2.69)	16.4 (3.28)	14.92 (2.98)
10 Months	Index Finger	14.03 (2.81)	20.2 (4.12)	17.25 (3.5)
	Whole Hand	.3 (.06)	.4 (.08)	.31 (.07)
	Total	14.06 (2.88)	20.6 (4.2)	17.6 (3.57)
12 Months	Index Finger	14.4 (3.06)	18.13 (3.41)	16 (3.24)
	Whole Hand	.65 (.09)	.33 (.12)	.49 (.1)
	Total	15.05 (3.15)	18.46 (3.53)	16.75 (3.34)

Note. Values in parentheses indicate the mean number of pointings per minute.

4.2.2.1. Do Maternal Pointings Increase over Time?

To assess whether the number of mother pointings (independent of them being index finger pointings or whole hand pointings) significantly changed over time we carried out Friedman's ANOVA. It was found that mother pointings did not increase over time ($\chi^2(2) = 3.86$, $df = 2$, $N = 35$, $p = .14$). We further separately investigated whether index finger or whole hand pointings of mothers changed over time. Friedman's ANOVA did not reveal significant changes over time for the number of maternal index finger pointing and whole hand pointing ($\chi^2(2) = 3.68$, $df = 2$, $N = 35$, $p = .16$; $\chi^2(2) = 1.96$, $df = 2$, $N = 35$, $p = .37$; respectively).

4.2.2.2. Socio-Economic Status (SES)

We could not find a SES-related difference in maternal pointings for the first time point of testing (Mann-Whitney $U = 126$, $p > .05$), for the second time point of testing

(Mann-Whitney $U = 113.5$, $p > .05$), and for the third time point of testing (Mann-Whitney $U = 138.5$, $p > .05$). When we separately looked at index finger pointing frequencies and whole hand pointing frequencies of mothers, there was no effect of SES on index finger pointing frequency for any of the time points ($F(1,33) = 1.16$, $p > .05$, $\eta^2 = .03$; $F(1,33) = 2.72$, $p > .05$, $\eta^2 = .07$; $F(1,33) = 1.01$, $p > .05$, $\eta^2 = .03$, respectively) and on whole hand pointing frequency for any of the time points ($U = 147.5$, $p > .05$; $U = 143$, $p > .05$; $U = 119.5$, $p > .05$, respectively).

4.2.2.3. Maternal Pointing Correlations

Mothers displayed a consistent trend over time in their number of index finger points. There were significant correlations between index finger pointings of mothers when their infants were 8 months old and when their infants were 10 months old ($r_s(35) = .56$, $p < .001$). There were significant correlations between their index finger pointings when their infants were 8 months old and when their infants were 12 months old ($r_s(35) = .45$, $p = .007$), and when their infants were 10 months old and 12 months old ($r_s(35) = .55$, $p = .001$). All p values reported were two-tailed.

There were no correlations between index finger pointings and whole hand pointings of mothers in any of the time points (please note that mothers showed much less frequent whole hand points than index finger points).

Table 6. *Summary of inter-correlations for index-finger and whole-hand pointings of mothers at 8 months, 10 months and 12 months*

Variable	1	2	3
1. Index-Finger Pointings (8Ms)	-	.56**	.45**
2. Index-Finger Pointings (10Ms)		-	.55**
3. Index-Finger Pointings (12Ms)			-

Note. ** $p < .01$ (2-tailed), $N = 35$

4.2.3. Infant Pointings in relation with Mother Pointings

We carried out a spearman's rank order correlation to determine the relations between infant and mother pointings at each time point. Since mothers did not show frequent whole hand pointings we included only their index finger pointings into the analyses. There was a significant correlation between the number of index-fingers pointings of mothers at 8 months and the number of whole hand pointings of infants at 10 months ($r_s(35) = .38, p = .023$, 2 tailed). There was also a significant relationship between the number of index-finger pointings of mother pointings at 10 months and the number of whole hand pointings of infants at the same time point ($r_s(35) = .34, p = .044$, 2 tailed).

We further carried out a spearman's rank order correlation to determine the relations between mother pointing at three time points and infant index finger pointing at 8 months (we included only the infants who were already pointing with their index fingers in the decorated room context at 8 months [$N = 7$]). The number of index finger pointings of 8 month old infants was significantly correlated with their mothers' index-finger pointings at 10 months ($r_s(7) = .78, p = .03$, 2 tailed).

4.2.3.1. Binary Logistic Regressions

We carried out various binary logistic regressions to predict whether infants would be pointing with their index fingers or whole hands or not when they were 8, 10 and 12 months from their mothers' index finger pointing frequencies.

We found that as mothers' number of index finger pointings at 8 months increased the probability that infant pointing behavior at 10 months (either index finger or whole hand behavior) would be equal to 1 (i.e. that pointing was exhibited) tended to increase (Wald's statistic = 4.09, $df = 1, p = .04$, $B = .11$, $\text{Exp}(B) = 1.12$, $SE = .05$). 1.12 unit increase in the number of index fingers pointings of mothers increased the odds that 10 month old infants pointed either with their index fingers or whole hands by 11%. We also found that as

mothers' number of index finger pointings at 8 months increased the probability that infants exhibited whole hand pointing at 10 months tended to increase (Wald's statistic = 5.3, $df = 1$, $p = .02$, $B = .13$, $\text{Exp}(B) = 1.14$, $SE = .05$). 1.14 unit increase in the number of index fingers pointings of mothers increased the odds that 10 month old infants pointed with their whole hands by 13%.

We further found that as mothers' number of index finger pointings at 10 months increased the probability that infants exhibited pointing at 10 months (either index finger or whole hand behavior) tended to increase (Wald's statistic = 4.82, $df = 1$, $p = .02$, $B = .11$, $\text{Exp}(B) = 1.12$, $SE = .05$). 1.12 unit increase in the number of index fingers pointings of mothers increased the odds that 10 month old infants pointed either with their index fingers or whole hands by 11%. We also found that as mothers' number of index finger pointings at 10 months increased the probability that infants exhibited whole hand pointing at 10 months tended to increase (Wald's statistic = 4.05, $df = 1$, $p = .04$, $B = .07$, $\text{Exp}(B) = 1.09$, $SE = .038$). 1.09 unit increase in the number of index fingers pointings of mothers increased the odds that 10 month old infants pointed with their whole hands by 7%.

4.3. PF Analyses for 8 months, 10 months and 12 months

There were 36 infants who completed all the lab visits at the ages of 8 months, 10 months and 12 months: 15 females, 21 males. Out of 36 infants there were 18 high SES infants (9 females, 9 males) and 14 low SES infants (6 females, 8 males). There were five infants in total who were either fussy in one trial, whose mothers intervened the task by pointing for the target poster, or with whom the experimenter erred by shifting her gaze between the target poster and the infant. See the table H4 in the Appendix H for the number of trials with mother or experimenter errors and for the number of trials in which the child was uncooperative. While calculating the percentages of look behaviors for these infants we

did not take into account the trials with the experimenter or mother error, or the trials in which the infant was fussy.

4.3.1. Analyses of Correct Look, Incorrect Look and No Look Behaviors at 8 months, 10 months and 12 months

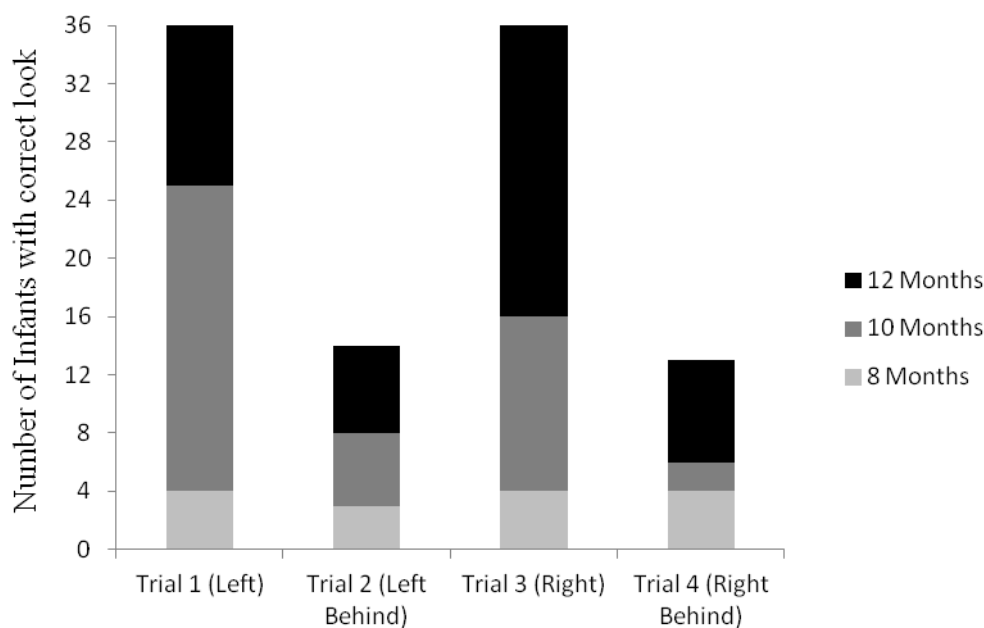


Figure 2. Number of infants with correct look behavior at each time point in every trial

Figure 2 shows number of infants and their correct look behaviors in each trial for every time point. When we investigated infants' performance in the very first trial for the first time point of testing there were 4 infants with correct look behavior (11.1% of 36 infants). For the second time point of testing (i.e. 10 months) there were 21 infants in the first trial with correct look behavior (58.3% of 36 infants). For the third time point of testing (i.e. 12 months) there were 24 infants in the very first trial with correct look behavior (66.6% of 36 infants). There was no order effect with respect to the number of infants who looked at the correct item on each trial at the first time point (Cochran's $Q = .257$, $N = 36$, $df = 3$, $p = .968$). Infants looked equally at the pointed items independent of their location. There was an order effect

with respect to the number of infants who looked at the correct item on each trial at the second time point (Cochran's $Q = 31.317$, $N = 36$, $df = 3$, $p = .00$) and at the third time point (Cochran's $Q = 29.547$, $N = 36$, $df = 3$, $p = .00$). At 10 and 12 months infants looked at the pointed item more often when the item was either on their left or on their right revealing that the order effect was robust at 10 months and at 12 months, and it was due to the direction of the items.

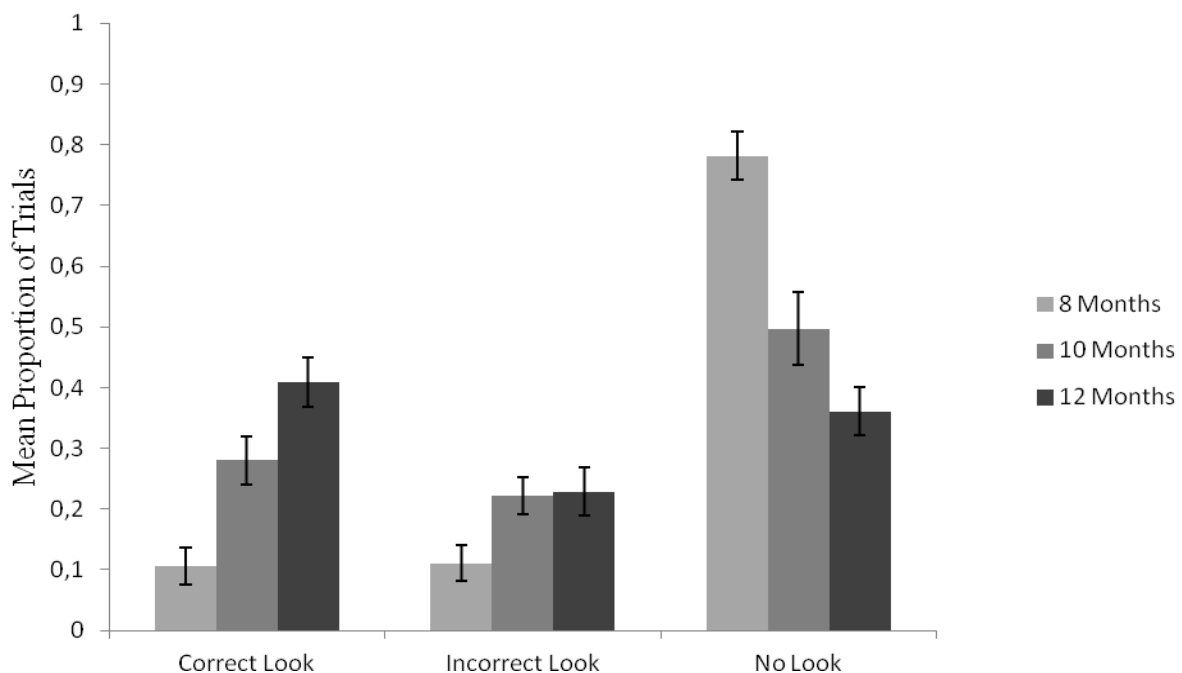


Figure 3. Mean proportion of trials with correct look, incorrect look and non-correct look at 8 months, 10 months and 12 months. Error bars show ± 1 SE.

As Figure 3 shows the percentage with which the infants looked at the targeted poster upon pointing prompt was 10.6% ($SD = 18.53$ %) at the first time point of testing, 28% ($SD = 24.49$ %) for the second time point of testing and 41% ($SD = 24.34$ %) for the third time point of testing. When a repeated measure of analysis was carried out with a between subject factor of time we found a significant change in correct look behaviors of infants over time ($F(2, 70) = 18.26$, $p < .001$, $\eta^2 = .34$) (Mauchly's test indicated that the assumption of sphericity was

not violated, $\chi^2(2) = .237, p = .88$). Pair wise comparisons revealed statistically significant differences between the percentages of correct look behaviors between 8 months and 10 months ($p = .002$), between 8 months and 12 months ($p < .001$), and between 10 months and 12 months ($p = .014$). There was a positively increasing trend in the percentages of correct looks over time.

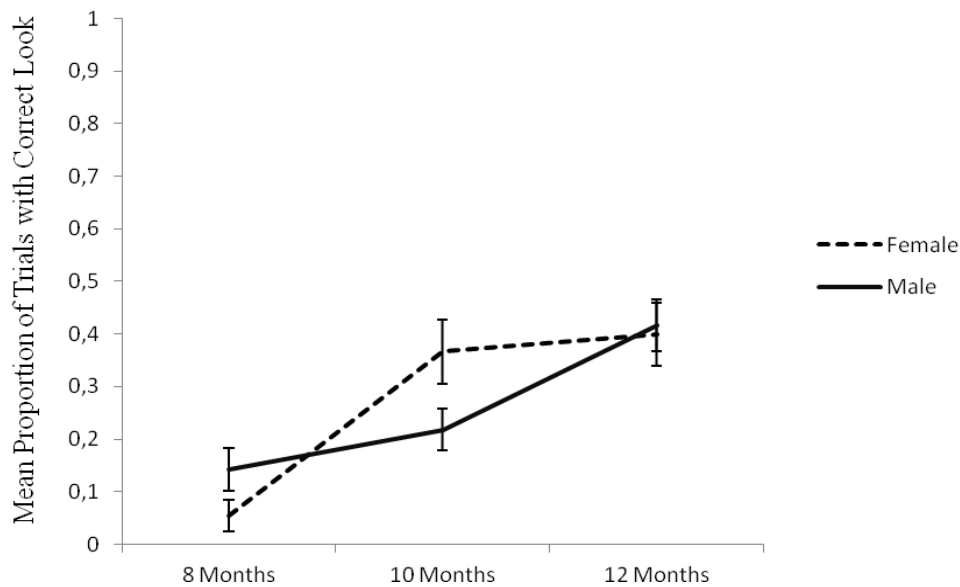


Figure 4. Female and male infants' mean proportion of trials with correct look at 8 months, 10 months and 12 months. Error bars show $\pm 1 SE$.

We further carried out a repeated measures of analysis with a within subject factor of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of sex (with two levels of female and male) for correct look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = .008, p = .996$). Overall pair wise comparison for sex showed that males and females did not differ from each other in terms of percentages of overall correct looks ($p = .76$; $M_{\text{female}}(15) = 27.4\%$, $SD = 14.6$, $M_{\text{male}}(21) = 25.92\%$, $SD = 14.6$). Yet there was a marginally significant sex x time interaction ($F(2, 70) = 2.96, p = .058, \eta^2 = .08$). As seen from Figure 4, for the first time point of testing

females and males did not differ in the percentage of correct looks (Levene's test revealed that variances are not equal $p = .016$, $t(31.92) = -1.55$, $p > .05$). However for the second time point of testing females had marginally more frequent correct look behaviors than males ($t(34) = 1.85$, $p = .072$). For the third time point of testing there were again no differences between females and males in correct look behaviors ($t(34) = -.2$, $p > .05$),

We also carried out a repeated measures of analysis with a within subject factor of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of SES (with two levels of high ($N = 18$) and low ($N = 14$) SES). Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = .167$, $p = .92$). We could not find an interaction between time and SES ($F(2, 60) = .56$, $p > .05$, $\eta^2 = .01$). High and low SES infants did not differ from each other in their correct look behaviors over time.

The percentage with which the infants looked at another poster than the pointed one was 11.1% ($SD = 19.31\%$) at the first time point of testing, 22.2% ($SD = 21.36\%$) for the second time point of testing and 22.9% ($SD = 22.65\%$) for the third time point of testing. When a repeated measure of analysis was carried out with a between subject factor of time we found a significant change in incorrect look behaviors of infants over time ($F(2, 70) = 4.12$, $p = .02$, $\eta^2 = .105$) (Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = .884$, $p = .643$). Pair wise comparisons revealed statistically significant differences between the percentages of incorrect look behaviors between 8 months and 10 months ($p = .03$) and between 8 months and 12 months ($p = .009$). Infants made fewer incorrect looks when they were 8 months in comparison with when they were 10 and 12 months old. There were no differences in the percentages of incorrect look behaviors between 10 months and 12 months ($p = .881$).

We further carried out a repeated measures of analysis with a within subject factor of time (with three levels of 8 months, 10 months and 12 months) and with a between subject

factor of sex (with two levels of female and male) for incorrect look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = 1.04, p = .593$ ($F(2, 68) = .67, p > .05, \eta^2 = .01$). Males and females did not differ from each other in the percentages of their incorrect look behaviors over time. A repeated measures of analysis and with a between subject factor of SES (with two levels of high ($N = 18$) and low ($N = 14$)) for incorrect look behaviors of infants revealed no significant SES x time interaction ($F(2, 60) = .6, p > .05, \eta^2 = .02$). Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = .832, p = .66$). High and low SES infants did not differ from each other in their incorrect look behaviors over time.

The percentage with which the infants did not look at any of the test items was 78.2% ($SD = 28.81\%$) at the first time point of testing, 49.76% ($SD = 38.13\%$) for the second time point of testing and 36.11% ($SD = 27.95\%$) for the third time point of testing. When a repeated measure of analysis was carried out with a between subject factor of time we found a significant change in no-look behaviors of infants over time ($F(2, 70) = 20.82, p < .001, \eta^2 = .37$) (Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = 4.249, p = .119$). Pair wise comparisons revealed statistically significant differences between the percentages of no look behaviors between 8 months and 10 months ($p = .001$), between 8 months and 12 months ($p < .001$), and between 10 months and 12 months ($p = .027$). Infants engaged in less and less no-look behaviors over time.

We further carried out a repeated measures of analysis with a within subject factor of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of sex (with two levels of female and male) for no-look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = 3.54, p = .17$ ($F(2, 68) = 1.37, p > .05, \eta^2 = .03$). Males and females did not differ from each other in their no-look behaviors over time. A repeated measures of analysis with a within subject factor of time

(with three levels of 8 months, 10 months and 12 months) and with a between subject factor of SES (with two levels of high ($N = 18$) and low ($N = 14$)) for no-look behaviors of infants revealed no significant SES x time interaction ($F(2, 60) = .97, p > .05, \eta^2 = .03$). Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 3.77, p = .15$). High and low SES infants did not differ from each other in their no-look behaviors over time.

4.3.2. Do the infants follow the targets in their visual field more easily than the items behind them over time?

We separately calculated the number of correct, incorrect and no-look behaviors in trials where the targets the experimenter was pointing at were to the left and to the right of the infants and where the targets the experimenter was pointing at were outside of the visual field of the infants (to the left behind and to the right behind of the infants).

Table 7. *Infants' mean number of correct looks, incorrect looks and no-looks at 8 months, 10 months and 12 months for left right trials and behind trials separately*

	Trials	Correct Look	Incorrect Look	No-Look
8 Months	Left & Right Trials	.22 (.48)	.14 (.35)	1.64 (.63)
	Behind Trials	.21 (.48)	.36 (.6)	1.45 (.71)
10 Months	Left & Right Trials	.94 (.8)	.17 (.38)	.89 (.86)
	Behind Trials	.21 (.41)	.76 (.74)	1.03 (.79)
12 Months	Left & Right Trials	1.26 (.7)	.14 (.35)	.6 (.69)
	Behind Trials	.36 (.54)	.8 (.75)	.83 (.78)

Note. Each cell shows the mean number of trials with standard deviations in parentheses.

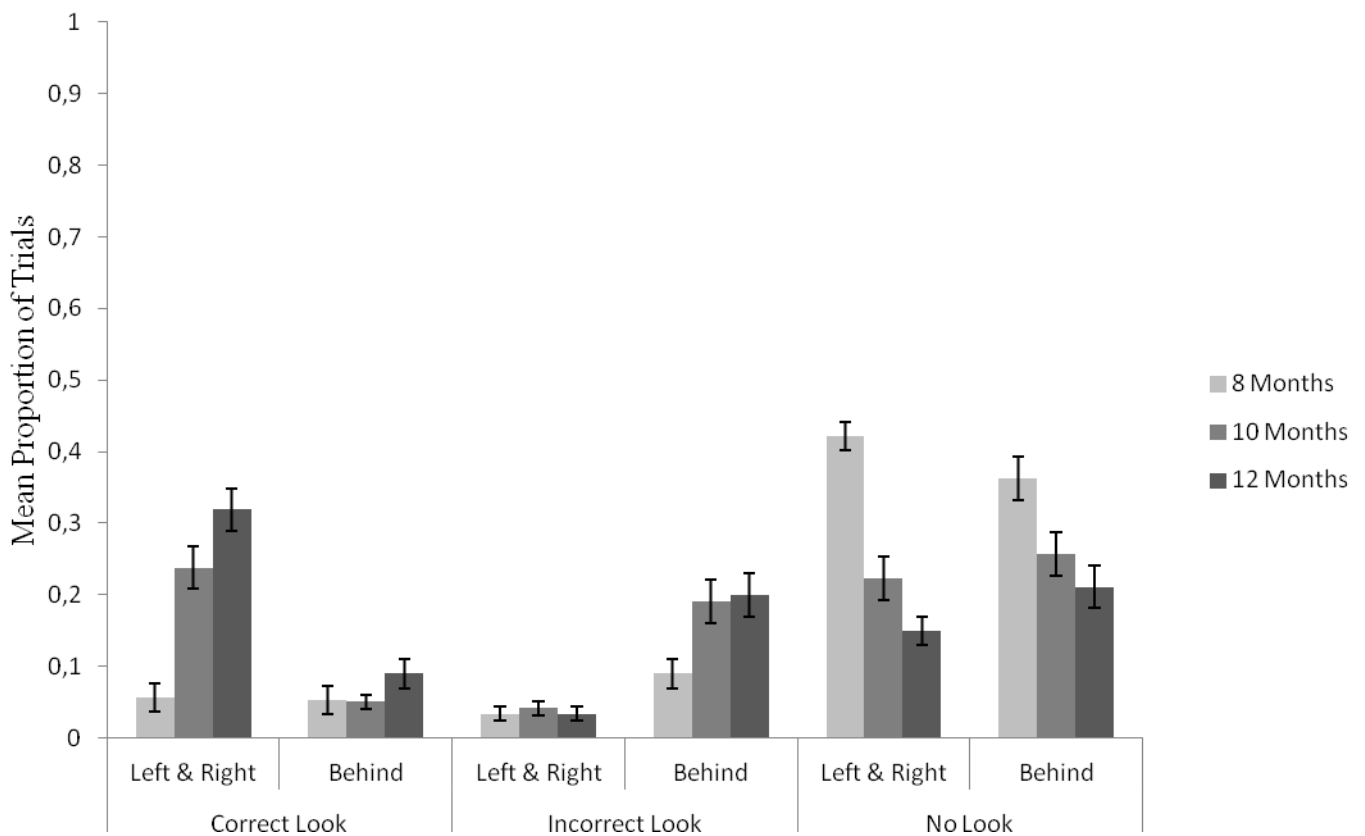


Figure 5. Mean proportion of trials with correct look, incorrect look and no-look for left right trials and behind trials separately at 8 months, 10 months and 12 months. Error bars show ± 1 SE.

There were no significant differences in the 8 month old infants' left and right, and behind trials in the percentages of correct looks ($t(32) = .00$, $p > .05$). There were significant differences in the percentages of correct looks between left and right, and behind trials when the infants were 10 months old ($t(33) = 5.17$, $p < .001$). As Figure 5 shows 10 months old infants' mean percentage of correct look behaviors for left and right trials was 23.8% ($SD = 20.12$) and mean percentage of correct look behaviors for behind trials was 5.14% ($SD = 10.26$). Infants looked correctly to the items more frequently when the items were in their visual field at 10 months. There were again significant differences in the percentages of correct looks between left right and behind trials when the infants were 12 months old ($t(34)$

= 6.44, $p < .001$). At the age of 12 months the infants' mean percentage of correct look behaviors for left and right trials was 31.9% ($SD = 18.24$) and mean percentage of correct look behaviors for behind trials was 9.02% ($SD = 13.56$). Infants again looked correctly to the items more frequently when the items were in their visual field at 12 months.

We carried out a repeated measure of analysis for correct look behaviors of infants at all three time points for left and right trials only. Infants more frequently looked correctly to the pointed item in time in left and right trials in time ($F(2, 66) = 23.02$, $p < .001$, $\eta^2 = .41$; Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 1.32$, $p = .51$). Infants' correct look behaviors' frequency for left and right trials increased significantly from 8 months to 10 months ($p < .001$), from 8 months to 12 months ($p < .001$), and from 10 months to 12 months ($p = .03$) ($M_{8\text{months}} = 6.12\%$, $SD = 12.57$; $M_{10\text{months}} = 23.52\%$, $SD = 20.12\%$; $M_{12\text{months}} = 31.9$, $SD = 18.24$, respectively).

A repeated measure of analysis for correct look behaviors of infants at all three time points for behind trials only did not reveal a significant main effect of time ($F(2, 62) = .66$, $p > .05$, $\eta^2 = .02$; Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 2.74$, $p = .25$). Infants did not more frequently look correctly to the pointed item in time for behind trials as they did for left and right trials.

There were significant differences in the 8 month old infants' left right and behind trials in the percentages of incorrect looks ($t(32) = -2.23$, $p = .03$). Infants' mean percentages for incorrect looks for the left and right trials was 3.78% ($SD = 9.1$), and for behind trials was 9.09% ($SD = 15.07$). There were again significant differences in the percentages of incorrect looks between left right and behind trials when the infants were 10 months old ($t(33) = -4.17$, $p < .001$). 10 months old infants' mean percentage of incorrect look behaviors for left and right trials was 4.41% ($SD = 9.67$) and mean percentage of incorrect look behaviors for behind trials was 19.11% ($SD = 18.52$). There were significant differences in the percentages

of incorrect looks between left right and behind trials when the infants were 12 months old too ($t(34) = -5.08, p < .001$). At the age of 12 months the infants' mean percentage of incorrect look behaviors for left and right trials was 3.57% ($SD = 8.87$) and mean percentage of incorrect look behaviors for behind trials was 20 % ($SD = 18.98$). For all time points, infants more frequently looked at another target other than the one pointed in the trials where the pointed items were behind their visual fields.

We carried out a repeated measure of analysis for incorrect look behaviors of infants at all three time points for left and right trials only. There was no main effect of time ($F(2, 66) = .08, p > .05, \eta^2 = .00$). Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 1.94, p = .37$). Infants' incorrect look behaviors' frequency did not decrease by time ($M_{8\text{months}} = 3.57\%, SD = 8.87$; $M_{10\text{months}} = 4.28\%, SD = 20.12$; $M_{12\text{months}} = 3.57\%, SD = 8.87$).

A repeated measure of analysis for incorrect look behaviors of infants at all three time points for behind trials revealed a significant main effect of time ($F(2, 62) = 4.82, p = .01, \eta^2 = .13$). Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = .21, p = .89$). Infants more frequently looked at another item other than the pointed one in the behind trials by time. Infants' incorrect look behaviors' frequency for behind trials increased from 8 months to 10 months ($p = .03$) and from 8 months to 12 months ($p = .005$). Infants' frequency of incorrect looks did not differ from each other at 10 months and at 12 months ($p = .557$) ($M_{8\text{months}} = 8.87\%, SD = 15.2$; $M_{10\text{months}} = 18.54\%, SD = 18.22$; $M_{12\text{months}} = 20.96\%, SD = 19.46$, respectively).

There were no significant differences in the 8 month old infants' left right and behind trials in the percentages of no looks ($t(32) = 1.53, p > .05$). Infants' mean percentages for no look behaviors for the left and right trials was 40.9% ($SD = 16.31$), and for behind trials was 36.36% ($SD = 17.77$). There were no significant differences in the percentages of no look

behaviors between left right and behind trials when the infants were 10 months old. $t(33) = -1.22, p > .05$). 10 months old infants' mean percentage of no look behaviors for left and right trials was 22.05% ($SD = 21.98$) and mean percentage of no look behaviors for behind trials was 25.73% ($SD = 19.92$). There were again no significant differences in the percentages of no-looks between left right and behind trials when the infants were 12 months old ($t(33) = 1.09, p > .05$). At the age of 12 months the infants' mean percentage of no look behaviors for left and right trials was 15.44% ($SD = 17.42$) and mean percentage of no look behaviors for behind trials was 19.85 % ($SD = 19.24$).

We carried out a repeated measure of analysis for no look behaviors of infants at all three time points for left and right trials only. There was a significant main effect of time ($F(2, 66) = 20.91, p < .001, \eta^2 = .38$; Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = 2.26, p = .32$). Infants' no look behaviors' frequency decreased by time. Infants' no look behaviors' frequency for left and right trials decreased from 8 months to 10 months ($p < .001$) and from 8 months to 12 months ($p < .001$). There was a marginally significant decrease in the frequency of infants' no-look behaviors from 10 months to 12 months as well ($p = .07$) ($M_{8\text{months}} = 42.12\%, SD = 16.77$; $M_{10\text{months}} = 22.38\%, SD = 21.74$; $M_{12\text{months}} = 15\%, SD = 20.54$, respectively).

A repeated measure of analysis for no look behaviors of infants at all three time points for behind trials only revealed a significant main effect of time ($F(2,60) = 8.75, p < .001, \eta^2 = .22$; Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = .7, p = .7$). Infants' no look behaviors' frequency for behind trials decreased from 8 months to 10 months ($p = .01$) and from 8 months to 12 months ($p < .001$). There were no significant decreases in the percentages of no-looks from 10 months to 12 months ($p = .14$) ($M_{8\text{months}} = 37.09\%, SD = 16.92$, $M_{10\text{months}} = 25.8\%, SD = 19.87$, $M_{12\text{months}} = 20.16\%, SD = 18.72$, respectively).

4.3.3. Infants' Spontaneous Pointing Behaviors during PF

There were 14 10 months old infants in total (38.8% of 36 infants) who pointed either with their index fingers or hands to one of the test items during the PF trials. Eight of them pointed with their index fingers to the task items at least once during the PF experiment. The maximum number of index finger pointings was six. 10 infants pointed with their whole hands at least once. Six infants used only their hands while pointing. The maximum number of whole hand pointings was five. There were four infants who used their hands while pointing to one item but their index fingers while pointing to another item during the PF experiment.

There were no sex related differences on the number of index finger pointings ($p = .214$) or on the number of whole hand pointings ($p = .6$) as Mann-Whitney U tests revealed. There were no SES related differences on the number of index finger pointings ($p = .925$) or on the number of whole hand pointings ($p = .319$) as Mann-Whitney U tests revealed

When 12 months, there were 12 infants in total (33.3% of 36 infants) who pointed either with their index fingers or hands to one of the test items during the PF trials. Nine of them pointed with their index fingers to the task items at least once during the PF experiment. The maximum number of index finger pointings was three. Four infants pointed with their whole hands at least once. Three infants used only their hands while pointing. The maximum number of whole hand pointings was three. There was one infant who used his hand while pointing to one item but his index finger while pointing to another item during the PF experiment.

There were no sex related differences on the number of index finger pointings ($p = .568$) or on the number of whole hand pointings as Mann-Whitney U tests revealed ($p = .874$). There were no SES related differences on the number of index finger pointings ($p = .398$) or on the number of whole hand pointings as Mann-Whitney U tests revealed ($p = .866$). 29% of

14 10 months old infants again showed spontaneous pointing behaviors (i.e. index finger pointings) when they were 12 months old.

4.3.4. Is greater performance in point following associated with spontaneous pointing production?

Infants' mean correct look percentages at 8 months were greater if they pointed spontaneously with their index fingers at 10 months in comparison to infants' correct look percentages at 8 months who did not show any spontaneous index finger pointings at 10 months ($F(1,34) = 7.26, p = .01, \eta^2 = .17$). Infants who pointed with their index fingers at 10 months were the ones who showed more frequent correct look behavior in the first testing session at 8 months in contrast with the ones who did not point with their index fingers at 10 months ($M_{\text{IndexPointer}} = 25\%, N = 8, SD = 11.64; M_{\text{Non-IndexPointer}} = 6.54\%, N = 28, SD = 29.88$). We also included whole-hand pointers to investigate whether spontaneous pointing production, independent of being produced with index-finger or whole hand, played a predictive role in explaining the difference in correct look percentages at 8 months. There were no significant differences ($F(1, 34) = 1.94, p > .05, \eta^2 = .05; N_{\text{Pointer}} = 14, N_{\text{Non-Pointer}} = 12$).

We also found that mean correct look percentages of infants who pointed spontaneously with their index fingers at 10 months were greater at 12 months in comparison with infants who did not point with their index fingers at 10 months ($F(1,34) = 5.97, p = .02, \eta^2 = .14$). Infants who pointed with their index fingers at 10 months ($N = 8$) showed more frequent correct look behavior at 12 months in contrast with the ones who did not point with their index fingers at 10 months ($N = 28$). ($M_{\text{Pointer}} = 58.3\%, SD = 22.27; M_{\text{Non-Pointer}} = 32.64\%, SD = 22.64$). We also included whole-hand pointers to investigate whether spontaneous pointing production results in a significant difference in correct look percentages at 12 months. There were 12 pointers and 24 non-pointers in total. There was a statistically

significant difference between pointers and non-pointers in the percentages of correct look behavior at 12 months ($F(1, 34) = 10.79, p < .001, \eta^2 = .05$). Infants who pointed either with their index fingers or whole hands spontaneously during the PF task at 10 months performed better in the point following when tested two months later ($M_{\text{Pointer}} = 57.63\%, SD = 18.95$; $M_{\text{Non-Pointer}} = 32.64\%, SD = 22.64$). There were no significant differences in the correct look percentages of index finger pointers ($N = 8$) and whole hand pointers ($N = 6$) at 12 months Mann-Whitney U tests revealed ($p = .414$). Although not significant, index-finger pointers at 10 months had greater correct look percentage at 12 months ($M_{\text{Indexpointer}} = 58.33\%, SD = 22.27$; $M_{\text{Wholepointer}} = 50\%, SD = 15.81$).

4.3.5. Do the infants' point following performances at 8 months predict their later point following skills?

We investigated whether correct look percentages of infants at 8 months predict their correct look percentages when they were 10 months in the point following task. The results were not statistically significant ($F(1, 34) = .07, p > .05$). We also investigated whether correct look percentages of infants at 8 months predict their correct look percentages when they were 12 months in the point following task. The results were not statistically significant ($F(1, 34) = .26, p > .05$). We further investigated whether correct look percentages of infants at 10 months predict their correct look percentages when they were 12 months in the point following task. The results were again not statistically significant ($F(1, 34) = 2.26, p > .05$). See Table I1 in Appendix I for correlated percentage scores for correct look, incorrect look and no look behaviors of infants at the three time points of testing.

4.3.6. In relation with Infant Pointings in the Decorated Room Context

There were six infants who pointed with their index finger at least once in the decorated room context at 8 months, 11 infants who pointed with their whole hands at least once in the decorated room context at 8 months but not with their index fingers and 13 infants

who did not point by any means at 8 months. There were 12 infants who pointed with their index finger at least once in the decorated room context at 10 months, nine infants who pointed with their whole hands at least once in the decorated room context at 10 months but not with their index fingers and nine infants who did not point by any means at 10 months. There were 22 infants who pointed with their index finger at least once in the decorated room context at 12 months, four infants who pointed with their whole hands at least once in the decorated room context at 12 months but not with their index fingers and four infants who did not point by any means at 12 months.

4.3.6. 1. In relation with Infant Pointing at 8 Months

4.3.6. 1.1. Correct Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

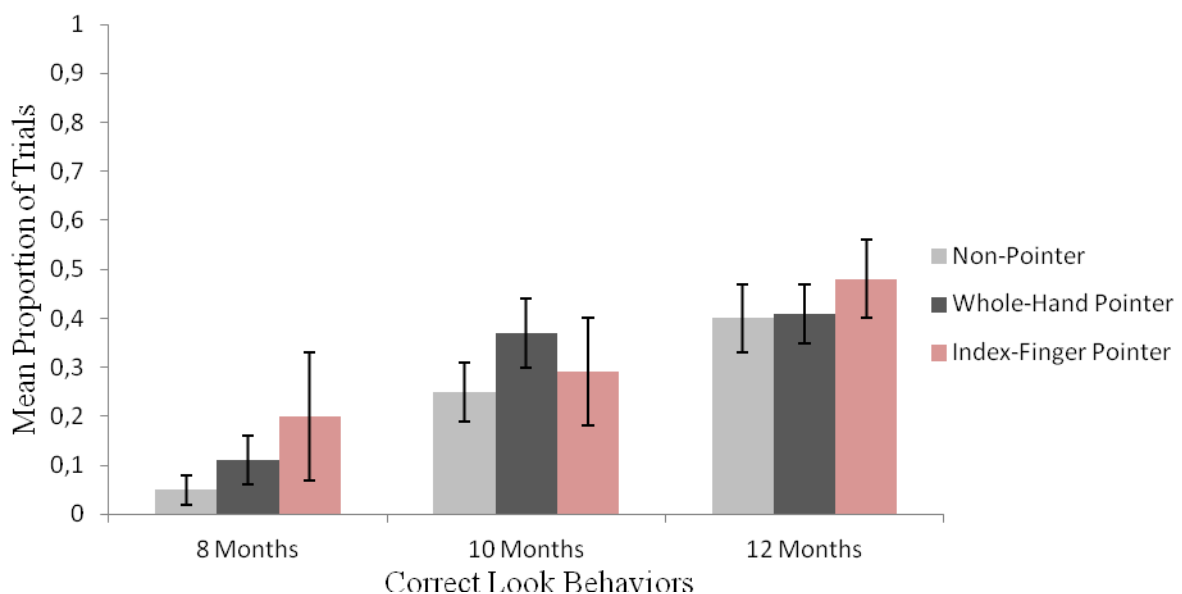


Figure 6. Mean proportion of correct look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 8 months. Error bars show $\pm 1 SE$.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for

correct look behaviors of infants at 8 months there was no main effect of pointing at 8 months on correct look behavior ($F(2,27) = 1.27, p > .05, \eta^2 = .08$). There was also no main effect of pointing at 8 months on correct looks at 10 months ($F(2, 27) = .69, p > .05, \eta^2 = .03$). For correct look behaviors of infants at 12 months, there was again no main effect of pointing ($F(2, 27) = .23, p > .05, \eta^2 = .01$).

We carried a repeated measure of analysis with a within subject variable of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of pointing at 8 months (with three levels of index finger pointing, whole hand pointing and non pointing) for correct look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = .05, p = .97$). There was no interaction between correct look percentages in three time points and pointing at 8 months ($F(4, 54) = .42, p > .05, \eta^2 = .03$). As Figure 6 displays that the infants, independent of them being index finger pointers, whole hand pointers or non-pointers at 12 months displayed more frequent correct look than when they were 8 month old ($p < .001$) and they all displayed more frequent correct look at 10 months than at 8 months ($p = .02$) but there were no differences in the correct look behaviors between 10 months and 12 months ($p = .11$).

4.3.6. 1.2. Incorrect Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

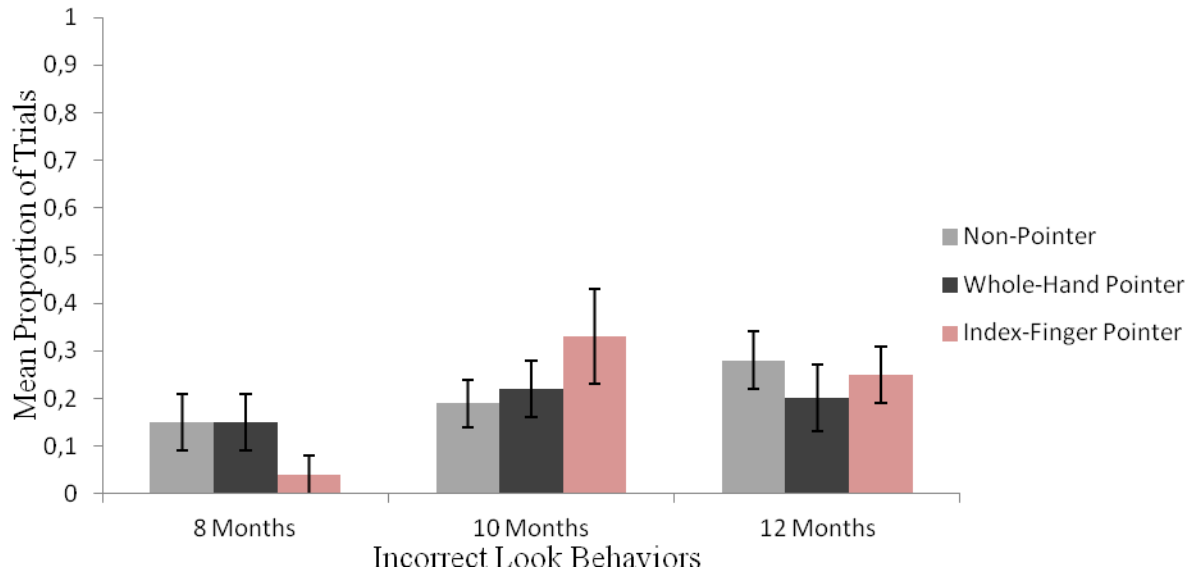


Figure 7. Mean proportion of incorrect look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 8 months. Error bars show $\pm 1 SE$.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for incorrect look behaviors of infants at 8 months there was no main effect of pointing on incorrect look behavior ($F(2,27) = .73, p > .05, \eta^2 = .05$). When we carried out anova for incorrect look behaviors of infants at 10 months there was no main effect of pointing at 8 months on incorrect look behaviors ($F(2,27) = .86, p > .05, \eta^2 = .06$). For incorrect look behaviors of infants at 12 months there was again no main effect of pointing at 8 months ($F(2,27) = .38, p > .05, \eta^2 = .02$).

We carried a repeated measure of analysis with a within subject variable of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of pointing at 8 months (with three levels of index finger pointing, whole hand pointing and non

pointing) for incorrect look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 1.11, p = .57$). There was no interaction between incorrect look percentages in three time points and pointing behavior of infants at 8 months ($F(4, 54) = 1.16, p > .05, \eta^2 = .08$). As Figure 7 displays that the infants, independent of them being index finger pointers, whole hand pointers or non-pointers at 8 months displayed marginally greater incorrect look behavior at 12 months than when they were 8 months ($p = .05$).

4.3.6. 1.3. No-Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

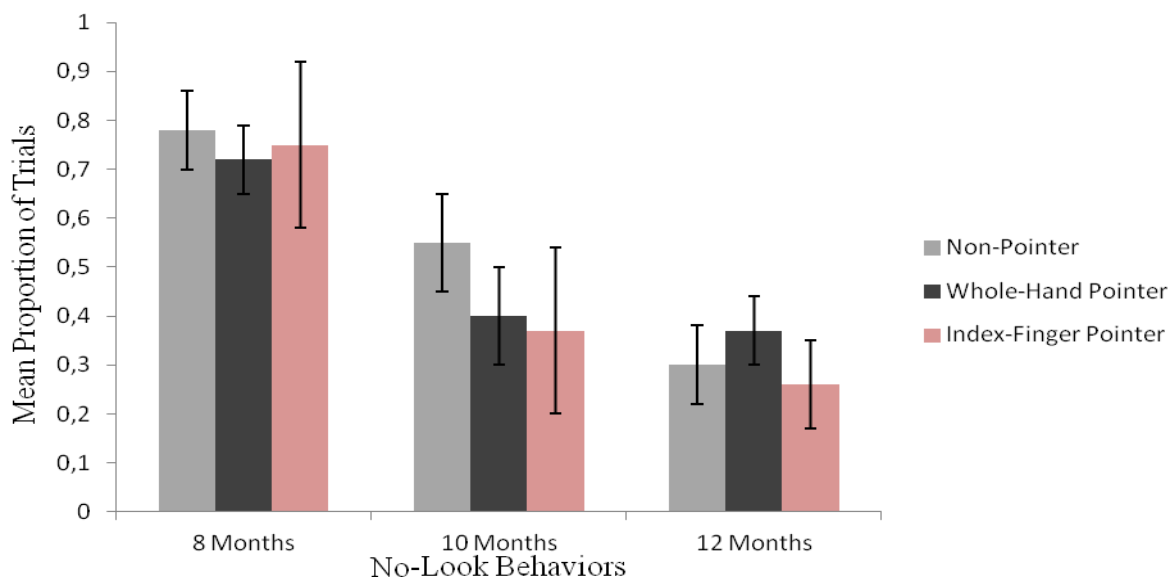


Figure 8. Mean proportion of no-look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 8 months. Error bars show $\pm 1 SE$.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for no-look behaviors of infants at 8 months there was no main effect of pointing on no-look behavior ($F(2,27) = .11, p > .05, \eta^2 = .009$). When we carried out anova for no-look behaviors of infants at 10 months there was no main effect of pointing at 8 months on no-look

behaviors ($F(2,27) = .71, p > .05, \eta^2 = .05$). For no-look behaviors of infants at 12 months there was again no main effect of pointing at 8 months ($F(2,27) = .38, p > .05, \eta^2 = .02$).

We carried a repeated measure of analysis with a within subject variable of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of pointing at 8 months (with three levels of index finger pointing, whole hand pointing and non pointing) for no-look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 5.5, p = .06$). There was no interaction between incorrect look percentages in three time points and pointing behavior of infants at 8 months ($F(4, 54) = .56, p > .05, \eta^2 = .04$). As Figure 8 displays all infants, independent of them being index finger pointers, whole hand pointers or non-pointers at 8 months displayed fewer no-look behavior at 12 months than when they were 8 months ($p < .001$) and at 10 months than when they were 10 months ($p = .006$).

4.3.6.2. In relation with Infant Pointing at 10 Months

4.3.6.2.1. Correct Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

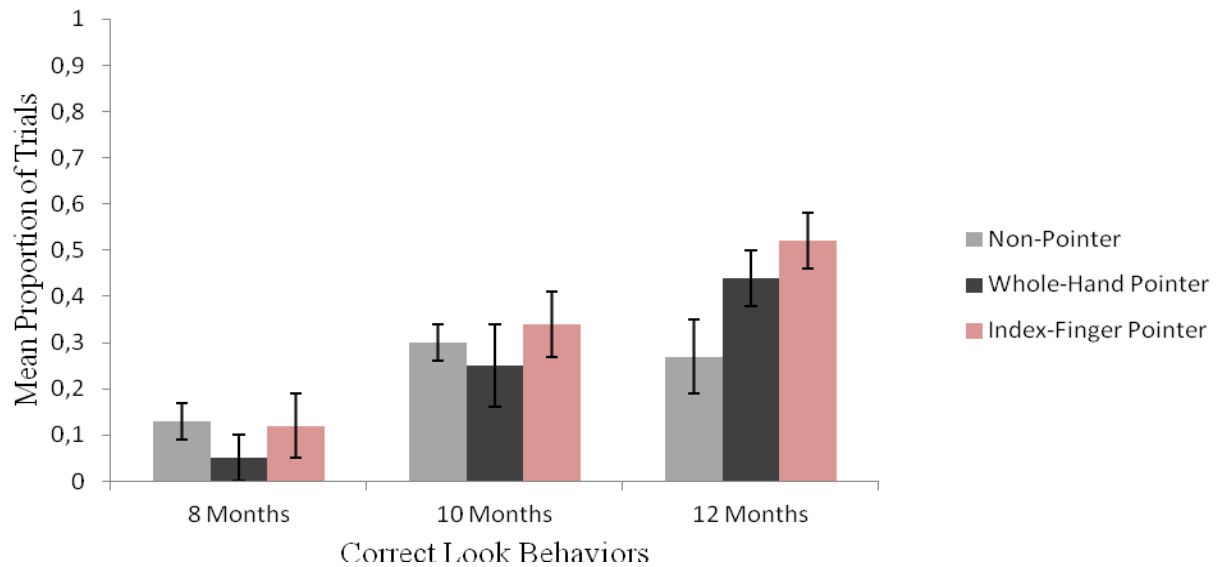


Figure 9. Mean proportion of correct look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 10 months. Error bars show $\pm 1 SE$.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for correct look behaviors of infants at 8 months there was no main effect of pointing at 10 months on correct look behavior ($F(2,27) = .47$, $p > .05$, $\eta^2 = .03$). When we carried out anova for correct look behaviors of infants at 10 months there was no main effect of pointing at 10 months on correct look behaviors ($F(2,27) = .32$, $p > .05$, $\eta^2 = .02$). For correct look behaviors of infants at 12 months there was a marginally significant effect of pointing at 10 months on correct look behaviors ($F(2,27) = 2.99$, $p = .06$, $\eta^2 = .18$). Index-finger pointers at 10 months old displayed marginally more correct look behaviors at 12 months ($M = 52.08$, $SD = 21.05$) than non pointers ($M = 27.77$, $SD = 26.03$) ($p = .05$) but not than whole hand

pointers ($M = 44.44$, $SD = 20.83$) ($p = .72$). Whole hand pointers and non pointers at 10 months did not differ from each other in their correct looks at 12 months ($p = .28$).

We also carried out a repeated measure of analysis with a within subject variable of time and a between subject factor of pointing at 10 months for correct look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = .69$, $p = .7$). There was no interaction between correct look percentages in three time points and pointing at 10 months ($F(4, 54) = 1.28$, $p > .05$, $\eta^2 = .08$). As Figure 9 displays all infants, independent of them being index finger pointers, whole hand pointers or non-pointers at 10 months displayed greater correct look behaviors when they were 12 months old in comparison to when they were 10 months old ($p < .001$), and they displayed more frequent correct looks when they were 10 months old in comparison to 8 months ($p = .01$).

4.3.6.2.2. Incorrect Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

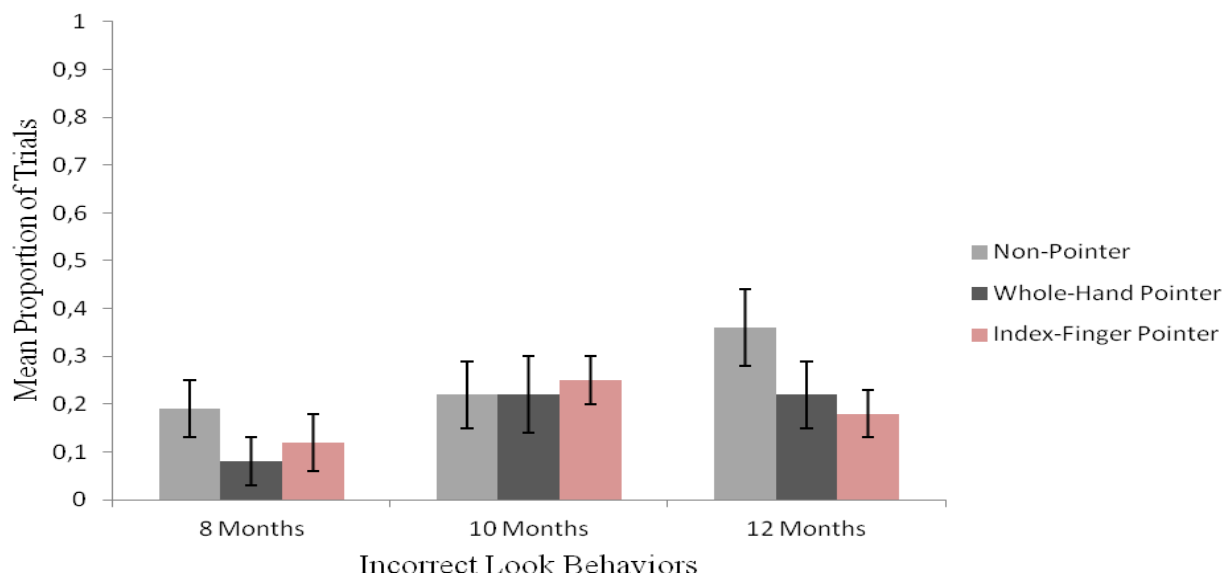


Figure 10. Mean proportion of incorrect look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 10 months.

Error bars show $\pm 1 SE$.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for incorrect look behaviors of infants at 8 months there was no main effect of pointing on incorrect look behavior ($F(2,27) = .66, p > .05, \eta^2 = .04$). When we carried out anova for incorrect look behaviors of infants at 10 months there was no main effect of pointing at 10 months on incorrect look behaviors ($F(2,27) = .05, p > .05, \eta^2 = .004$). For incorrect look behaviors of infants at 12 months there was again no main effect of pointing at 10 months ($F(2,27) = 1.66, p > .05, \eta^2 = .11$).

We carried a repeated measure of analysis with a within subject variable of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of pointing at 10 months (with three levels of index finger pointing, whole hand pointing and non pointing) for incorrect look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 1.93, p = .38$). There was no interaction between incorrect look percentages in three time points and pointing behavior of infants at 10 months ($F(4, 54) = .7, p > .05, \eta^2 = .05$). As Figure 10 displays all infants, independent of them being index finger pointers, whole hand pointers or non-pointers at 10 months displayed marginally more incorrect look behaviors at 12 months than when they were 8 months ($p = .06$).

4.3.6.2.3. No-Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

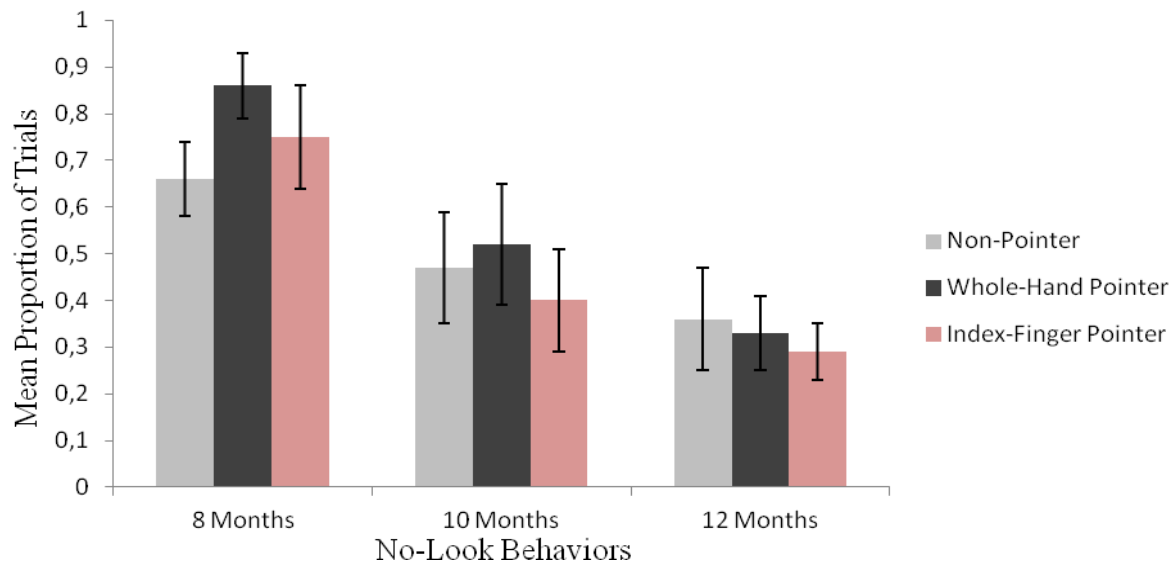


Figure 11. Mean proportion of no-look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 10 months. Error bars show $\pm 1 SE$.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for no-look behaviors of infants at 8 months there was no main effect of pointing on no-look behavior ($F(2,27) = .92, p > .05, \eta^2 = .06$). When we carried out anova for no-look behaviors of infants at 10 months there was no main effect of pointing at 10 months on no-look behaviors ($F(2,27) = .24, p > .05, \eta^2 = .01$). For no-look behaviors of infants at 12 months there was again no main effect of pointing at 10 months ($F(2,27) = .16, p > .05, \eta^2 = .01$).

We carried a repeated measure of analysis with a within subject variable of time (with three levels of 8 months, 10 months and 12 months) and with a between subject factor of pointing at 10 months (with three levels of index finger pointing, whole hand pointing and non pointing) for no-look behaviors. Mauchly's test indicated that the assumption of

sphericity was not violated ($\chi^2(2) = 4.45, p = .1$). There was no interaction between no-look behavior percentages in three time points and pointing behavior of infants at 8 months ($F(4, 54) = .41, p > .05, \eta^2 = .03$). As Figure 11 displays all infants, independent of them being index finger pointers, whole hand pointers or non-pointers at 10 months displayed more frequent no-look behavior at 8 months than when they were 10 months ($p = .008$), and when they were 12 months old ($p < .01$).

4.3.6.3. In relation with Infant Pointing at 12 Months

4.3.6.3.1. Correct Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

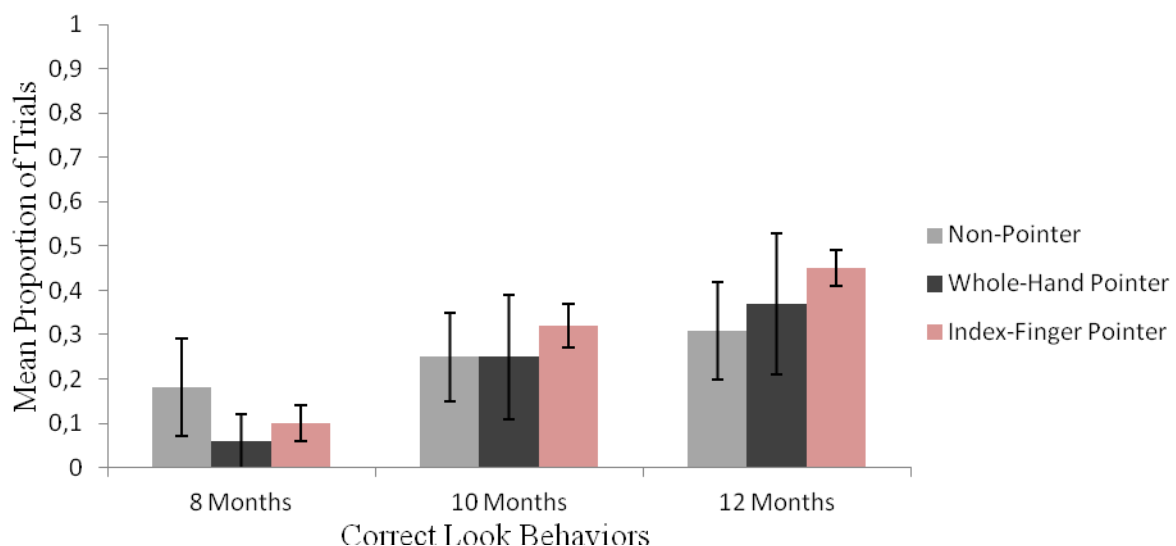


Figure 12. Mean proportion of correct look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 12 months. Error bars show $\pm 1 SE$.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for correct look behaviors of infants at 8 months there was no main effect of pointing at 12 months on correct look behavior ($F(2,27) = .44, p > .05, \eta^2 = .03$). When we carried out

anova for correct look behaviors of infants at 10 months there was no main effect of pointing at 12 months on correct look behaviors ($F(2,27) = .23$, $p > .05$, $\eta^2 = .01$). For correct look behaviors of infants at 12 months there was no significant effect of pointing at 12 months on correct look behaviors ($F(2,27) = .99$, $p = .06$, $\eta^2 = .04$).

We further carried out a repeated measure of analysis with a within subject variable of time and a between subject factor of pointing at 12 months for correct look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = .26$, $p = .87$). There was no interaction between correct look percentages in three time points and pointing at 12 months ($F(4, 54) = .47$, $p > .05$, $\eta^2 = .03$). As Figure 12 displays all infants, independent of them being index finger pointers, whole hand pointers or non-pointers at 12 months displayed more frequent correct look behavior at 12 months in comparison to when they were 8 months old ($p = .004$).

4.3.6.3.2. Incorrect Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

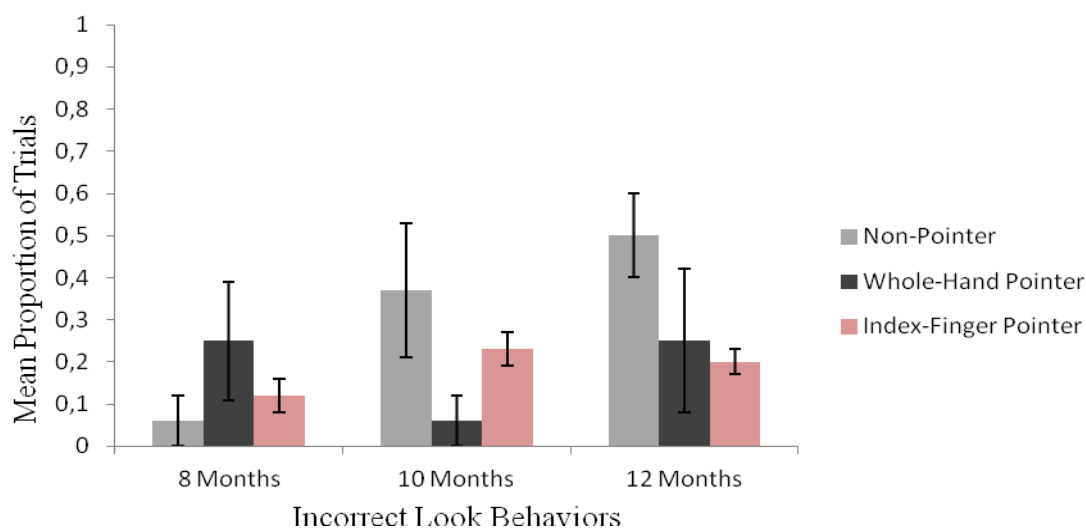


Figure 13. Mean proportion of correct look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 12 months. Error bars show ± 1 SE.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for incorrect look behaviors of infants at 8 months there was no main effect of pointing on incorrect look behavior ($F(2,27) = .9, p > .05, \eta^2 = .06$). When we carried out anova for incorrect look behaviors of infants at 10 months there was no main effect of pointing at 12 months on incorrect look behaviors ($F(2,27) = 2.82, p > .05, \eta^2 = .12$). For incorrect look behaviors of infants at 12 months there was a marginally significant effect of pointing at 12 months ($F(2, 27) = 3.31, p = .05, \eta^2 = .19$). As Figure 13 displays non-pointing infants at 12 months showed more incorrect look behavior at 12 months in comparison with index finger pointing infants at 12 months ($p = .04$). There were no significant differences in index finger pointing and whole hand pointing infants' incorrect look behaviors ($p > .05$) or in whole hand pointing and non pointing infants' incorrect look behaviors ($p > .05$).

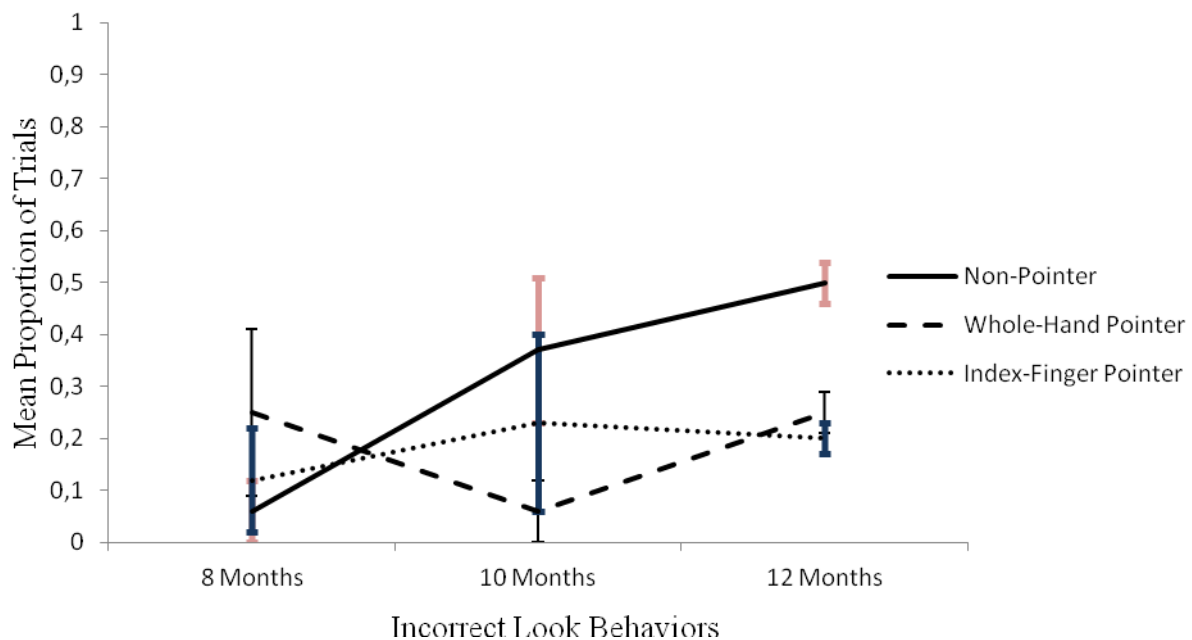


Figure 14. Mean proportion of incorrect look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 12 months. Error bars show $\pm 1 SE$.

We further carried out a repeated measure of analysis with a within subject variable of time and a between subject factor of pointing at 12 months for incorrect look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 1.37, p = .5$). There was a statistically significant interaction between incorrect look percentages in three time points and pointing behavior of infants at 12 months ($F(4, 54) = 2.93, p = .02, \eta^2 = .17$). As seen from Figure 14 non-pointers' incorrect look behavior frequency increased significantly in time. At 10 months, index finger pointers' incorrect look behavior frequency increased whereas whole hand pointers' incorrect look behavior frequency decreased (yet this difference was not significant) in comparison to when they were 8 months old. Index finger pointers and whole hand pointers showed fewer incorrect look behaviors at 12 months than non pointers.

4.3.6.3.3. No-Look Behaviors of Index Finger Pointers, Whole Hand Pointers and Non-Pointers

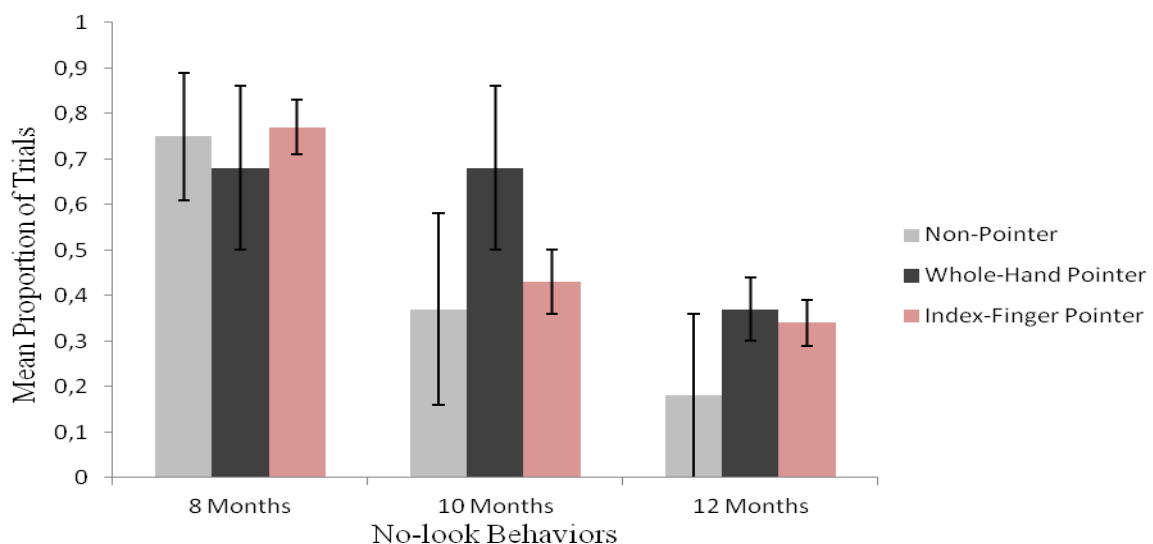


Figure 15. Mean proportion of correct look behaviors at 8 months, 10 months and 12 months for index finger pointing, whole hand pointing and no-pointing infants at 12 months. Error bars show $\pm 1 SE$.

When we carried out an analysis of variance with a between subject factor of pointing levels (with three levels of index finger pointing, whole hand pointing, and non-pointing) for no-look behaviors of infants at 8 months there was no main effect of pointing on no-look behavior ($F(2,27) = .12, p > .05, \eta^2 = .009$). When we carried out anova for no-look behaviors of infants at 10 months there was no main effect of pointing at 12 months on no-look behaviors ($F(2,27) = .86, p > .05, \eta^2 = .06$). For no-look behaviors of infants at 12 months there was again no main effect of pointing at 12 months ($F(2,27) = .62, p > .05, \eta^2 = .04$).

We further carried out a repeated measure of analysis with a within subject variable of time and a between subject factor of pointing (with two levels of index finger pointing and non-index finger pointing) at 12 months for no look behaviors. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2(2) = 4.72, p = .09$). There was no interaction between no-look percentages in three time points and pointing at 12 months ($F(2, 56) = .54, p > .05, \eta^2 = .01$). As Figure 15 displays all infants at 8 months displayed more frequent no-look behaviors in comparison to when they were 10 months ($p = .03$) and 12 months ($p < .001$). They also displayed more no-look behaviors at 10 months in comparison to when they were 12 months old ($p = .04$).

4.3.6.4. Intercorrelations with Infant Pointing

We carried out a spearman's rank order correlation to determine the relations between the pointing behaviors of infants and the infants' point following skills. The percentage with which infants correctly looked at the target item at 8 months was strongly correlated with infants' number of whole hand pointings at 12 months ($r_s(30) = .4, p = .02, 2 \text{ tailed}$). Infants' number of whole hand pointings at 10 months was strongly correlated with the percentage with which infants correctly looked at the target item at 12 months ($r_s(30) = .39, p = .03, 2 \text{ tailed}$).

4.3.6.5. Intercorrelations with Mother Pointing

We carried out a spearman's rank order correlation to determine the relations between the pointing behaviors of mothers and their infants' point following skills. Mothers' number of pointings at 8 months was positively correlated with the percentage with which infants displayed correct look behavior at 10 months ($r_s(30) = .38, p = .03, 2 \text{ tailed}$) and negatively correlated with the percentage with which infants displayed no-look behavior at 10 months ($r_s(30) = -.37, p = .04, 2 \text{ tailed}$)

4.4. Mullen Scales of Early Learning (MSEL) Analyses

There were 58 infants for the final sample of the MSEL task at the first time point: 23 females, 35 males with the mean age of 259.86 in days ($SD = 8.21$) and 8.53 in months (the age range was between 244 days and 277 days; Skewness = .57, $p > .05$; Kurtosis = 1.28, $p > .05$). There were 26 high SES infants (12 females, 14 males) and 21 low SES infants (8 females, 13 males). For the second time point of testing there were 48 infants for the MSEL task: 18 females, 30 males with the mean age of 325.27 in days ($SD = 8.13$) and 10.68 in months (the age range was between 309 days and 343 days; Skewness = .5, $p > .05$; Kurtosis = 1.08, $p > .05$). There were 23 high SES infants (10 females, 13 males) and 18 low SES infants (7 females, 11 males). For the third time point of testing there were 44 infants for the MSEL task: 17 females, 27 males with the mean age of 383.07 in days ($SD = 8.82$) and 12.58 in months (the age range was between 363 days and 400 days; Skewness = .18, $p > .05$; Kurtosis = .78, $p > .05$). There were 23 high SES infants (10 females, 13 males) and 18 low SES infants (7 females, 11 males). There were 23 high SES infants (10 females, 13 males) and 16 low SES infants (7 females, 9 males).

There were 35 infants who completed all the three testing sessions of MSEL: 15 females and 20 males. 17 of them (9 females, 8 males) were high SES and 14 of them (6 females, 8 males) were low SES.

4.4.1. 8 months, 10 months and 12 months

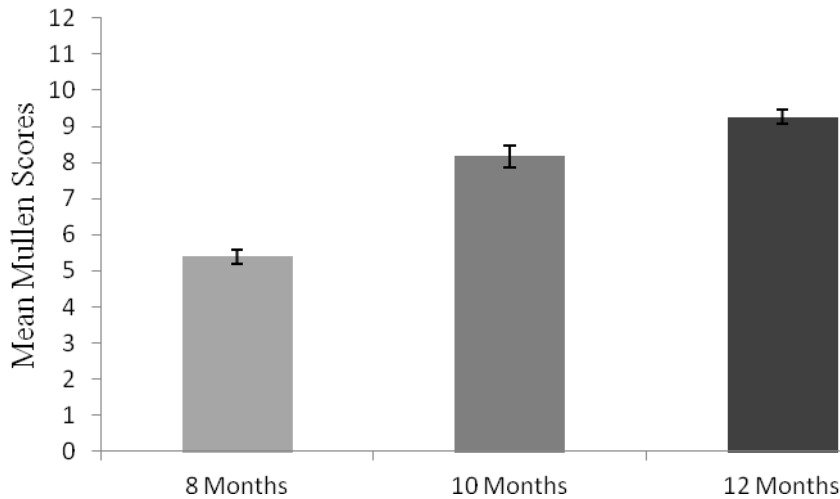


Figure 16. Infants' mean MSEL scores at 8 months, 10 months and 12 months. Error bars show $\pm 1 SE$.

When a repeated measure of analysis was carried out with a factor of time (with three levels of 8 months, 10 months and 12 months) we found a significant effect of time ($F(2,68) = 64.6, p = .00, \eta^2 = .65$). (Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = 2.29, p = .31$). As Figure 16 shows infants performed better at MSEL task in time. The mean MSEL scores at 8 months, 10 months and 12 months were 5.4 ($SD = 1.49$), 8.17 ($SD = 1.88$), and 9.26 ($SD = 1.35$), respectively. Pair wise comparisons revealed that differences in MSEL scores between all time points were significant (8-10: $p < .001$; 8-12: $p < .001$; 10-12: $p = .001$). ANOVA with one within subject factor of time (with three levels of 8 months, 10 months and 12 months) and a between subject factor of sex (with two levels of female and male) did not reveal time and sex interaction ($F(2,66) = .28, p > .05, \eta^2 = .008$). (Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = 2.29, p = .31$).

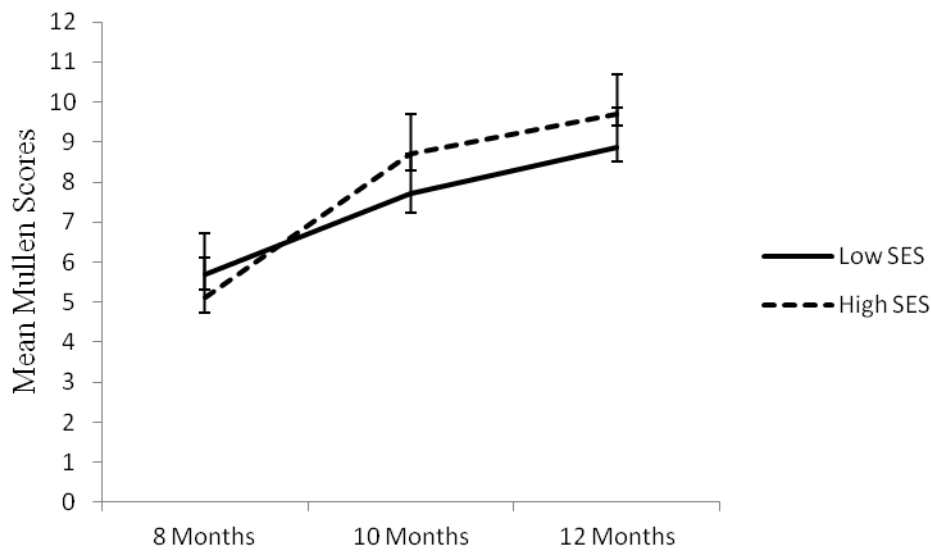


Figure 17. Mean MSEL scores at 8 months, 10 months and 12 months according to SES. Error bars show $\pm 1 SE$.

ANOVA with one within subject factor of time (with three levels of 8 months, 10 months and 12 months) and a between subject factor of SES (with two levels of high and low) revealed a marginally significant time and SES interaction ($F(2,58) = 2.68, p = .07, \eta^2 = .085$). (Mauchly's test indicated that the assumption of sphericity was not violated, $\chi^2(2) = .796, p = .672$). Low SES infants' mean MSEL scores at 8 months was 5.71 ($SD = 1.32$) whereas high SES infants' mean MSEL scores at the same age was slightly lower, 5.11 ($SD = 1.69$). Yet this difference was not statistically significant ($t(29) = 1.07, p > .05$). There were also no differences between two SES groups in their scores at 10 months ($t(29) = 1.52, p > .05$). As Figure 17 displays low SES infants' mean MSEL scores at 12 months was 8.86 ($SD = 1.4$) whereas high SES infants' mean MSEL scores at the same age was higher than their low SES counterparts 9.71 ($SD = 1.1$). This difference was marginally significant ($t(29) = 1.88, p = .07$).

4.4.2. In Relation with Infant Pointing

We carried out an analysis of variance with a between subject factor of pointing at 8 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 8 months. There were no differences between index finger pointing, whole hand pointing and non-pointing infants at 8 months in their MSEL scores at 8 months ($F(2,26) = 1.18, p > .05, \eta^2 = .08$). We carried out an analysis of variance with a between subject factor of pointing at 10 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 8 months. There were statistically significant differences between index finger pointing, whole hand pointing and non-pointing infants at 10 months in their MSEL scores at 8 months ($F(2,26) = 4.17, p = .02, \eta^2 = .24$). Pair wise comparisons with Bonferroni correction revealed that whole hand pointing infants at 10 months scored better than non-pointing infants in MSEL when they were 8 months old ($p = .02$) but there were no differences in their 8 month MSEL scores of index finger pointing and whole hand pointing infants ($p > .05$) and index finger pointing and non pointing infants ($p > .05$). We further carried out an analysis of variance with a between subject factor of pointing at 12 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 8 months. There were no differences between index finger pointing, whole hand pointing and non-pointing infants at 12 months in their MSEL scores at 8 months ($F(2,26) = .59, p > .05, \eta^2 = .04$).

We carried out an analysis of variance with a between subject factor of pointing at 8 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 10 months. There were no differences between infants in their MSEL scores at 10 months ($F(2, 26) = .2, p > .05, \eta^2 = .01$). We carried out an analysis of variance with a between subject factor of pointing at 10 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 10 months. There were no

differences between index finger pointing, whole hand pointing and non-pointing infants at 10 months in their MSEL scores at 10 months ($F(2,26) = .97, p > .05, \eta^2 = .07$). We carried out an analysis of variance with a between subject factor of pointing at 12 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 10 months. There were no differences between index finger pointing, whole hand pointing and non-pointing infants at 12 months in their MSEL scores at 10 months ($F(2,26) = .08, p > .05, \eta^2 = .006$).

We carried out an analysis of variance with a between subject factor of pointing at 8 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 12 months. There were no differences between index finger pointing, whole hand pointing and non-pointing infants at 8 months in their MSEL scores at 12 months ($F(2,26) = .97, p > .05, \eta^2 = .07$). We carried out an analysis of variance with a between subject factor of pointing at 10 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 12 months. There were no differences between index finger pointing, whole hand pointing and non-pointing infants at 10 months in their MSEL scores at 12 months ($F(2,26) = .2, p > .05, \eta^2 = .01$). We carried out an analysis of variance with a between subject factor of pointing at 12 months (with three levels of index finger pointing, whole hand pointing and non-pointing) for MSEL scores at 12 months. There were no differences between index finger pointing, whole hand pointing and non-pointing infants at 12 months in their MSEL scores at 10 months ($F(2,26) = .01, p > .05, \eta^2 = .001$).

4.4.3. In Relation with Maternal Pointing

Index finger pointing frequency of mothers at 8 months did not significantly predict fine motor skill score of infants at 8 months ($F(1, 27) = .22, p > .05$), or at 10 months ($F(1, 27) = .1, p > .05$) or at 12 months ($F(1, 27) = 3.09, p > .05$). Index finger pointing frequency of mothers at 10 months did not significantly predict fine motor skill score of infants at 10

months ($F(1, 27) = .57, p > .05$) or at 12 months ($F(1, 27) = 1.7, p > .05$). Index finger pointing frequency of mothers at 12 months did not significantly predict fine motor skill score of infants at 12 months ($F(1, 27) = 1.78, p > .05$)

4.5. TIGE Analyses at 10 Months and 12 Months

There were 42 infants whose mothers were interviewed to fill out the communicative development inventory (TIGE) for their infants at two time points. Out of 42 infants there were 21 high SES infants (9 females, 12 males) and 17 low SES infants (7 females, 10 males). Coding of pointing behavior in the decorated room was done for 35 out of these 42 infants. Thus the analyses run to assess the relation between pointing and early language was based on the sample size of 35, whereas all the remaining analyses which were concerned only with TIGE utilized 42 infants, otherwise reported.

Table 8 shows each category and the number of items in each subsection of TIGE-I.

Table 8. *Number of items in each category of TIGE-1*

Part I: Early Words		# of Items
A. First signs of understanding		3
B. Phrases		28
C. Starting to talk		2
D. Vocabulary		418
1. Sound effects and animal sounds	Comprehension	
	Production	
2. Animals	Comprehension	
	Production	
3. Vehicles	Comprehension	
	Production	

4. Toys	8	Comprehension Production
5. Food and drink	43	Comprehension Production
6. Clothing	18	Comprehension Production
7. Body parts	17	Comprehension Production
8. Small household items	27	Comprehension Production
9. Furniture and rooms	22	Comprehension Production
10. Things outside	21	Comprehension Production
11. Places to go	13	Comprehension Production
12. People	21	Comprehension Production
13. Games and routines	31	Comprehension Production
14. Action words	95	Comprehension Production
15. Descriptive words	25	Comprehension Production

16. Words about time	6	Comprehension
		Production
17. Pronouns	12	Comprehension
		Production
18. Question words	7	Comprehension
		Production
19. Prepositions and locations	10	Comprehension
		Production
20. Quantifiers and articles	8	Comprehension
		Production
Part I: Total	451	Comprehension
		Production

Part II: Actions and Gestures

A. First communicative gestures	32
B. Games and routines	8
C. Actions with objects	17
D. Pretending to be a parent	13
E. Imitating adult actions	14
F. Pretend Play	1
Part II: Total	85
Total	536

4.5.1. Early Words**4.5.1.1. First Signs of Language Understanding**

The data for the section of “First Signs of Language Understanding” were not normally distributed for 10 months and 12 months ($M = 2.9$, $SD = .29$, Skewness = -7.94,

Kurtosis = .09; $M = 2.98$, $SD = .15$, Skewness = -.18, Kurtosis = 58.579, respectively).

Wilcoxon signed test revealed that there were no differences between two time points in infants' scores in the section of "First Signs of Language Understanding" ($Z = 1.34$, $p > .05$).

There were no SES related differences in the first signs of language understanding at 10 months ($F(1, 36) = 1.64$, $p > .05$, $\eta^2 = .04$) or at 12 months ($F(1, 36) = 1.24$, $p > .05$, $\eta^2 = .03$). No sex differences were found at 10 months ($F(1, 40) = .25$, $p > .05$, $\eta^2 = .00$) or at 12 months ($F(1, 40) = .61$, $p > .05$, $\eta^2 = .01$). There was further no interaction between sex and time points ($F(1, 40) = .63$, $p > .05$, $\eta^2 = .01$) and between SES and time points ($F(1, 36) = .35$, $p > .05$, $\eta^2 = .01$).

There were seven index finger pointers, 12 whole hand pointers, and 16 non pointers at 8 months. Pointing level at 8 months did not make a difference on first signs of language understanding at 10 months as Kruskal Wallis tests revealed ($H = 3.49$, $p = .16$) or at 12 months ($H = 1.18$, $p > .05$). There were 14 index finger pointers, 11 whole hand pointers, and 10 non pointers at 10 months. Pointing level at 10 months did not make a difference on first signs of language understanding at 10 months as Kruskal Wallis tests revealed ($H = .18$, $p > .05$) or at 12 months ($H = 2.18$, $p > .05$). There were 26 index finger pointers, five whole hand pointers, and four non pointers at 12 months. Pointing level at 12 months did not make a difference on first signs of language understanding at 10 months as Kruskal Wallis tests revealed ($H = 1.51$, $p > .05$) or at 12 months ($H = .34$, $p > .05$).

4.5.1.2. Phrases

The data for the section of "Phrases" were normally distributed for 10 months and 12 months ($M = 15.64$, $SD = 4.9$, Skewness = -.11, Kurtosis = .69; $M = 20.55$, $SD = 4.9$, Skewness = -2.11, Kurtosis = .05, respectively). As paired sample t test revealed there were statistically significant differences between two time points in the number of phrases infants comprehended ($t(41) = -7.6$, $p < .001$). Infants comprehended more phrases when they were

12 months old in comparison to when they were 10 months old. Spearman's rank order correlation further showed that the number of phrases infants comprehended at 10 months and at 12 months were significantly correlated ($r_s(42) = .63, p < .001$). There were no SES related differences in the number of phrases infants comprehended at 10 months ($F(1, 36) = 1.32, p > .05, \eta^2 = .03$) or at 12 months ($F(1, 36) = .1, p > .05, \eta^2 = .003$). No sex differences were found in the phrases comprehended at 10 months ($F(1, 40) = .02, p > .05, \eta^2 = .00$) or at 12 months ($F(1, 40) = .01, p > .05, \eta^2 = .00$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) for phrases also revealed no interaction between time and sex ($F(1, 40) = .002, p > .05, \eta^2 = .00$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of SES (with two levels of high SES and low SES) was carried out for phrases. There was no interaction between time and SES ($F(1, 36) = .92, p > .05, \eta^2 = .02$).

An analysis of variance with a within subject factor of time and a between subject factor of pointing behavior at 8 months (with three levels of index finger pointing, whole hand pointing and no pointing) was also carried out. There was no interaction between time and 8 month pointing level ($F(2, 32) = 1.65, p > .05, \eta^2 = .09$) or between time and 10 month pointing level ($F(2, 32) = .24, p > .05, \eta^2 = .01$) or between time and 12 month pointing level ($F(2, 32) = 1.72, p > .05, \eta^2 = .09$).

Pointing level at 8 months did not make a difference on understanding of phrases at 10 months as analysis of variance revealed ($F(2,32) = .24, p > .05, \eta^2 = .01$). The effect of pointing level at 8 months on understanding of phrases at 12 months has just failed to reach significance ($F(2, 32) = 2.67, p = .08, \eta^2 = .14$). Infants who did not display any pointing behavior at 8 months were reported as understanding fewer phrases ($M(16) = 19.00, SD = 1.22$) than infants who displayed whole hand pointing at the same age ($M(12) = 23.08, SD =$

1.41) at the alpha level of .09. Index finger pointing infants at 8 months ($M(7) = 19.14$, $SD = 1.85$) did not differ from non-pointing ($p = .11$) or whole hand pointing infants ($p = .3$) in the number of phrases they comprehended. Pointing level at 10 months did not make a difference on understanding of phrases at 10 months ($F(2, 32) = .20$, $p > .05$, $\eta^2 = .01$) or at 12 months ($F(2, 32) = .02$, $p > .05$, $\eta^2 = .001$). Pointing level at 12 months made marginally significant effect on understanding of phrases at 10 months ($F(2, 32) = 3.14$, $p = .05$, $\eta^2 = .16$; $H = 6.26$, $p = .03$). Infants who did not display any pointing behavior at 12 months were the ones who were previously reported as understanding fewer phrases ($M(4) = 10$, $SD = 1.15$) than index finger pointers ($M(26) = 16.5$, $SD = 5.33$), but not than whole hand pointers ($M(5) = 16.4$, $SD = 3.28$). According to post hoc analyses using Tukey's HSD the difference between non-pointing and index finger pointing infants in understanding of phrases was significantly different ($p = .04$). Yet there were no significant differences between whole hand pointers and index finger pointers ($p = .99$), or between whole hand pointers and non-pointers ($p = .13$). Pointing level at 12 months did not make an effect on understanding of phrases at 12 months ($F(2, 32) = 1.58$, $p > .05$, $\eta^2 = .09$).

4.5.1.3. Starting to Talk

The data for the section of "Starting to Talk" were normally distributed for 10 months and 12 months, with the range of values between 0% to 100% ($M = 29.76\%$, $SD = 30.36\%$, Skewness = 2.02, Kurtosis = .63; $M = 35.97\%$, $SD = 27.97\%$, Skewness = 1.06, Kurtosis = .52, respectively). As paired sample t test revealed there were no significant differences between two time points in the number of items infants imitated or named ($t(40) = 1.37$, $p > .05$). Spearman's rank order correlation showed that the number of items infants imitated or named at 10 months and at 12 months were significantly correlated ($r_s(41) = .57$, $p < .001$). There were no SES related differences in the starting to talk items at 10 months ($F(1, 36) = .17$, $p > .05$, $\eta^2 = .00$) but high SES infants scored significantly higher than low SES at 12

months ($F(1, 35) = 5.25, p = .02, \eta^2 = .13$). Mean percentage score of low SES infants at 12 months was 25 ($SD = 23.38, N = 17$) and mean percentage score for high SES infants at the same age was 45 ($SD = 28.39, N = 20$). No sex differences were found in starting to talk items at 10 months ($F(1, 40) = .00, p > .05, \eta^2 = .00$) or at 12 months ($F(1, 39) = .97, p > .05, \eta^2 = .02$). Further, there was no interaction between sex and time points ($F(1, 39) = .9, p > .05, \eta^2 = .02$) or between SES and time points ($F(1, 35) = 2.62, p > .05, \eta^2 = .07$).

Pointing level at 8 months did not make a difference on starting to talk items at 10 months as analysis of variance revealed ($F(2,32) = .26, p > .05, \eta^2 = .01$) or at 12 months ($F(2,31) = .28, p > .05, \eta^2 = .01$). Pointing level at 10 months did not make a difference on at 10 months as analysis of variance revealed ($F(2, 32) = .2, p > .05, \eta^2 = .01$) or at 12 months ($F(2, 31) = .31, p > .05, \eta^2 = .02$).). Pointing level at 12 months did not make a difference on starting to talk items at 10 months ($F(2, 32) = .09, p > .05, \eta^2 = .006$) or at 12 months ($F(2, 31) = .77, p > .05, \eta^2 = .04$).

4.5.1.4. Vocabulary Comprehension

We treated all 418 items in the Part I of TIGE-I, whether they were propositions or animal sounds, as belonging the same category of “vocabulary” and carried out the analyses explained below.

The data for the vocabulary comprehension were normally distributed for 10 months and 12 months ($M = 109.74, SD = 72.74, \text{Skewness} = 2.5, \text{Kurtosis} = .14$; $M = 167.81, SD = 72.45, \text{Skewness} = .05, \text{Kurtosis} = .01$, respectively). As paired sample t test revealed there were statistically significant differences between two time points in the number of vocabulary infants comprehended ($t(37) = 7.52, p < .001$). Infants comprehended more vocabulary when they were 12 months old in comparison to when they were 10 months old. Spearman’s rank order correlation further showed that the number of vocabulary infants comprehended at 10 months and at 12 months were significantly correlated ($r_s(38) = .82, p < .001$). There were

no SES related differences for the number of words comprehended at 10 months ($F(1, 32) = 1.39, p > .05, \eta^2 = .04$) or at 12 months ($F(1, 36) = 1.81, p > .05, \eta^2 = .04$). No sex differences were found for the number of vocabulary comprehended at 10 months ($F(1, 36) = .72, p > .05, \eta^2 = .02$) or at 12 months ($F(1, 40) = 1.15, p > .05, \eta^2 = .02$).

An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) for vocabulary comprehension revealed no interaction between time and sex ($F(1, 36) = .05, p > .05, \eta^2 = .001$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of SES (with two levels of high SES and low SES) was carried out for vocabulary comprehension. There was no interaction between time and SES ($F(1, 32) = .11, p > .05, \eta^2 = .003$). There was no interaction between time and 8 month pointing level ($F(2, 28) = .69, p > .05, \eta^2 = .04$) or between time and 10 month pointing level ($F(2, 28) = .58, p > .05, \eta^2 = .04$) or between time and 12 month pointing level ($F(2, 28) = .48, p > .05, \eta^2 = .03$) for vocabulary comprehension.

Pointing level at 8 months did not make a difference on vocabulary comprehension at 10 months as analysis of variance revealed ($F(2, 28) = 1.6, p > .05, \eta^2 = .1$) or at 12 months ($F(2, 32) = .78, p > .05, \eta^2 = .04$). Pointing level at 10 months did not make a difference on vocabulary comprehension at 10 months ($F(2, 28) = .14, p > .05, \eta^2 = .01$) or at 12 months ($F(2, 32) = .29, p > .05, \eta^2 = .01$). Pointing level at 12 months made a slightly marginal difference on vocabulary comprehension at 10 months ($F(2, 28) = 2.59, p = .09, \eta^2 = .15; H = 5.54, p = .06$). Index-finger pointing infants at 12 months were the ones who were reported as comprehending more vocabulary ($M(22) = 127.63, SD = 15.12$) than non-pointing infants at 12 months ($M(4) = 43.75, SD = 35.48$) at the alpha level .09 (Mann Whitney U test also revealed that $U = 13, p = .02$). There were no differences between whole hand pointers ($M(5)$

= 91.2, $SD = 31.73$) and index finger pointers ($p = .56$ or $U = 39.5$, $p = .34$) or between whole hand pointers and non pointers ($p = .58$ or $U = 4$, $p = .19$) in the number of vocabulary they comprehended at 10 months.

Pointing level at 12 months made a marginally significant difference on vocabulary comprehension at 12 months too ($F(2, 32) = 2.91$, $p = .06$, $\eta^2 = .15$; $H = 6.93$, $p = .03$). Index-finger pointing infants at 12 months were reported as comprehending mean vocabulary of 187.23 ($SD = 13.98$) at 12 months, whereas whole hand pointing infants and non pointing infants at the same age were reported as comprehending mean vocabulary of 128 ($SD = 31.88$) and 112.75 ($SD = 35.64$), respectively. Mann-Whitney U test revealed that the difference between index-finger pointing and non-pointing infants was significant ($U = 14$, $p = .01$), whereas the difference between index-finger pointing and whole hand pointing infants was not ($U = 34.5$, $p = .1$). There were no significant differences between whole hand pointing infants and non-pointing infants at 12 months in their vocabulary comprehension ($U = 10$, $p > .1$).

4.5.1.5. Vocabulary Production

The data for the vocabulary production were not normally distributed for 10 months and 12 months ($M = 8.13$, $SD = 9.65$, Skewness = 6.44, Kurtosis = 9.89; $M = 15.76$, $SD = 12.78$, Skewness = 5, Kurtosis = 5.28, respectively). Wilcoxon signed test revealed that there were statistically significant differences between two time points in the number of vocabulary infants produced ($Z = -4.88$, $p < .001$). Median number of vocabulary produced for infants at 10 months and at 12 months were 6 (2-10) and 12 (7-20). Infants produced more vocabulary when they were 12 months old in comparison to when they were 10 months old. Spearman's rank order correlation further showed that the number of vocabulary infants produced at 10 months and at 12 months were significantly correlated ($r_s(38) = .73$, $p < .001$). There were no SES related differences in the vocabulary produced at 10 months ($F(1, 32) = .5$, $p > .05$, $\eta^2 =$

.01) or at 12 months ($F(1, 36) = .93, p > .05, \eta^2 = .02$). Neither were there sex differences in the vocabulary produced at 10 months ($F(1, 36) = .12, p > .05, \eta^2 = .00$) or at 12 months ($F(1, 40) = .8, p > .05, \eta^2 = .00$).

An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) was further carried out for vocabulary production. There was no interaction between time and sex ($F(1, 36) = .2, p > .05, \eta^2 = .006$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of SES (with two levels of high SES and low SES) was carried out for vocabulary production. There was no interaction between time and SES ($F(1, 32) = .73, p > .05, \eta^2 = .02$). There was no interaction between time and 8 month pointing level ($F(2, 28) = .4, p > .05, \eta^2 = .02$) or between time and 10 month pointing level ($F(2, 28) = 1.53, p > .05, \eta^2 = .09$) or between time and 12 month pointing level ($F(2, 28) = 2.1, p > .05, \eta^2 = .13$) for vocabulary production.

However, when we aggregated whole hand pointers and non-pointers at 12 months to compare them with index finger pointing infants at the same age, an analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of pointing behavior (with two levels of index finger pointing and non index-finger pointing) at 12 months showed a marginally significant interaction between time and pointing behaviors for vocabulary production ($F(1,29) = 3.37, p = .07, \eta^2 = .1$).

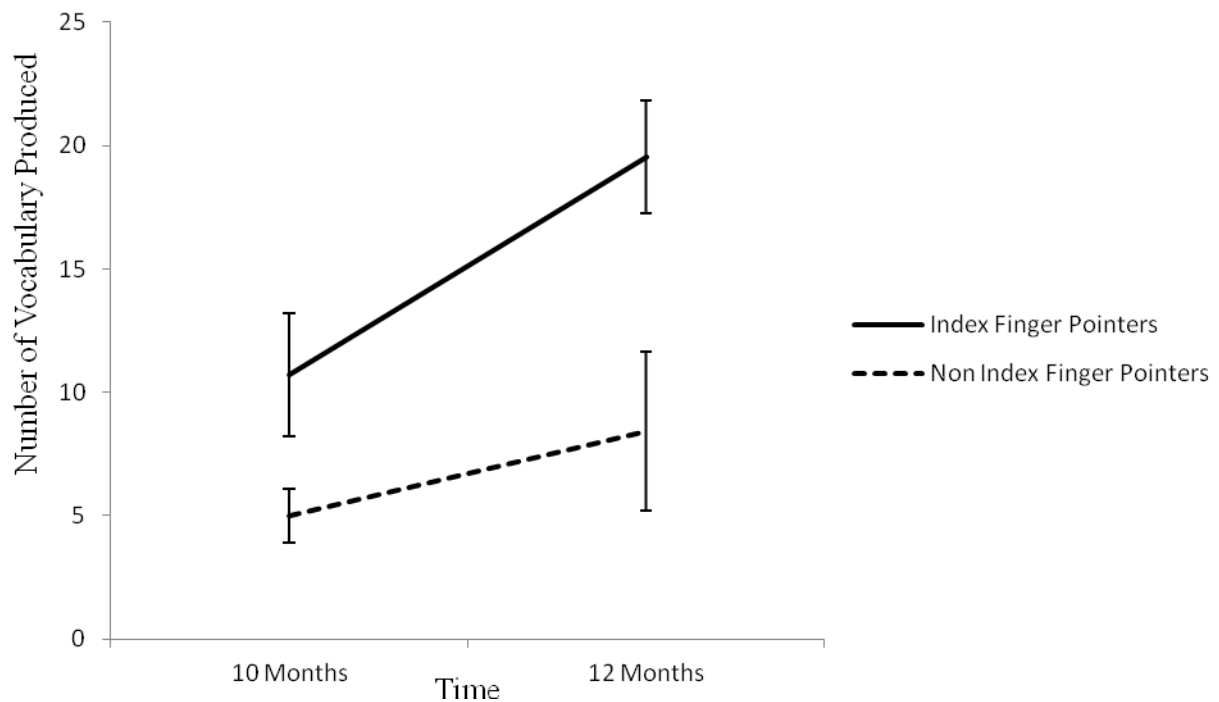


Figure 18. Mean number of vocabulary produced in 10 months and 12 months by index-finger pointers and non-index finger pointers at 12 months. Error bars show ± 1 SE.

As Figure 18 shows, non-index finger pointing infants at 12 months did not differ in the vocabulary they produced at 10 months and 12 months ($F(1,8) = 2.82, p > .05, \eta^2 = .26$), but index-finger pointing infants at 12 months produced more vocabulary at 12 months compared to 10 months ($F(1,21) = 28.03, p < .001, \eta^2 = .57$). Thus, vocabulary development from 10 months to 12 months was at a higher rate for 12 month old index finger pointers than infants who did not display index finger points.

Further when we carried out a separate analysis of variance for vocabulary production at 10 months with pointing factor at 12 months (with two levels of index finger pointing or non-index finger pointing) pointing did not make a significant difference on vocabulary production at 10 months ($F(1,29) = 2.05, p > .05, \eta^2 = .06$). However, it made a significant difference on vocabulary production at 12 months ($F(1, 33) = 5.37, p = .02, \eta^2 = .14$). As Figure 18 also displays, index finger pointers were reported to produce a mean number of

19.84 words ($SD = 14.07$) whereas non-index finger pointers were reported to produce a mean number of 8.44 words ($SD = 6.91$)

4.5.1.6. Action Word Comprehension

We separately investigated 94 action word items in the Part I of TIGE-I and carried out the analyses explained below.

The data for the action-word comprehension were normally distributed for 10 months and 12 months ($M = 28.26$, $SD = 19.94$, Skewness = 1.69, Kurtosis = .82; $M = 47.07$, $SD = 20.37$, Skewness = -.16, Kurtosis = .69, respectively). As a paired sample t test revealed there were statistically significant differences between two time points in the number of action-words infants comprehended ($t(37) = 7.05$, $p < .001$). Infants comprehended more action words when they were 12 months old in comparison to when they were 10 months old. Spearman's rank order correlation further showed that the number of action words infants comprehended at 10 months and at 12 months were significantly correlated ($r_s(38) = .74$, $p < .001$). Low SES infants were reported to comprehend more action words ($M = 37.75$, $SD = 20.31$, $N = 15$) than high SES infants ($M = 22.82$, $SD = 18.92$, $N = 19$) at 10 months ($F(1, 32) = 4.86$, $p = .03$, $\eta^2 = .13$). Also at 12 months, low SES infants were reported to comprehend more action words ($M = 57.52$, $SD = 18.91$, $N = 17$) than high SES infants ($M = 42.6$, $SD = 21.48$, $N = 21$) $F(1, 36) = 5.03$, $p = .03$, $\eta^2 = .12$). There were no sex related differences in the actions words comprehended at 10 months ($F(1, 36) = .72$, $p > .05$, $\eta^2 = .02$) or at 12 months ($F(1, 40) = .63$, $p > .05$, $\eta^2 = .01$).

An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) was further carried out for action word comprehension. There was no interaction between time and sex ($F(1, 36) = .07$, $p > .05$, $\eta^2 = .002$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between

subject factor of SES (with two levels of high SES and low SES) was carried out for action word comprehension. There was no interaction between time and SES ($F(1, 32) = .42, p > .05, \eta^2 = .01$).

There was no interaction between time and 8 month pointing level ($F(2, 28) = .5, p > .05, \eta^2 = .03$) or between time and 12 month pointing level ($F(2, 28) = 1.04, p > .05, \eta^2 = .06$) for action-word comprehension. We found a marginally significant interaction between pointing level at 10 months and time on the number of action words comprehended ($F(2,28) = 2.82, p = .07, \eta^2 = .16$).

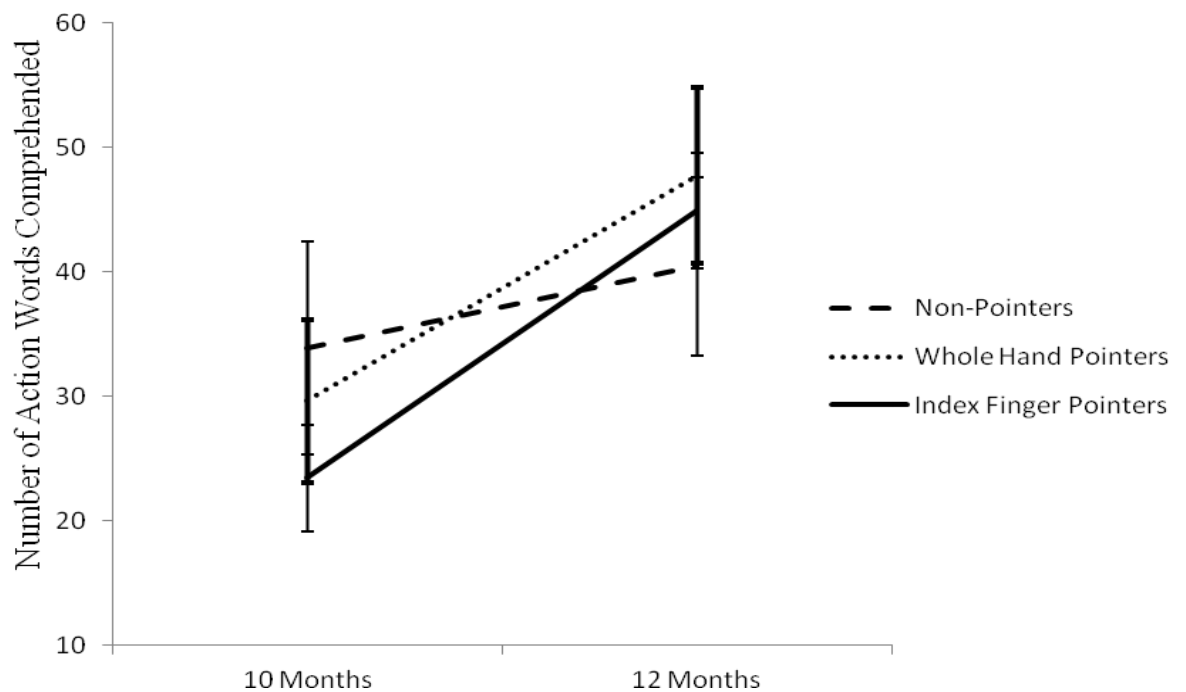


Figure 19. Mean number of action words comprehended in 10 months and 12 months by index-finger pointers, whole hand pointers and non-pointers at 10 months. Error bars show ± 1 SE.

As Figure 19 shows there were significant differences between 10 month old index finger pointers in the number of action words they comprehended at 10 months and 12 months ($F(1,9) = 22.45, p = .001, \eta^2 = .71$). Index finger pointing infants at 10 months were

reported to comprehend an average of 23.42 words ($SD = 14.91$) at 10 months whereas the mean increased to 44.92 ($SD = 16.03$) at 12 months. There were also significant differences between 10 month old whole hand pointers in the number of action words they comprehended between two time points ($F(1,11) = 25.64, p < .001, \eta^2 = .7$). Whole hand pointing infants at 10 months were reported to comprehend an average of 29.6 action words ($SD = 20.7$) at 10 months whereas the mean increased to 47.7 ($SD = 22.31$) at 12 months. Non-pointer infants did not show any significant increase in the action words they comprehended ($F(1, 8) = 1.34, p > .05, \eta^2 = .14$).

Pointing level at 8 months did not make a difference on action word comprehension at 10 months as analysis of variance revealed ($F(2,28) = 2.08, p > .05, \eta^2 = .13$) or at 12 months ($F(2,32) = .82, p > .05, \eta^2 = .04$). Pointing level at 10 months did not make a difference on action word comprehension at 10 months ($F(2, 28) = .7, p > .05, \eta^2 = .04$) or at 12 months ($F(2, 32) = .39, p > .05, \eta^2 = .02$). Nor did pointing level at 12 months made a significant difference on action word comprehension at 10 months ($F(2, 28) = 2.21, p > .05, \eta^2 = .13$) or at 12 months ($F(2, 32) = 1.16, p > .05, \eta^2 = .06$).

4.5.1.7. Action Word Production

The data for the action word production were not normally distributed for 10 months and 12 months ($M = .95, SD = 2.14, \text{Skewness} = 8.84, \text{Kurtosis} = 17.58; M = 1.71, SD = 2.29, \text{Skewness} = 9.25, \text{Kurtosis} = 20.31$, respectively). Wilcoxon signed test revealed that there were statistically significant differences between two time points in the number of action words infants produced ($Z = -2.92, p = .003$). Median number of action words produced for infants at 10 months and at 12 months were 0 (0-1) and 1 (0-2). Infants produced more action words when they were 12 months old in comparison to when they were 10 months old. There were no SES differences in the action words produced at 10 months ($F(1, 32) = 2.77, p > .05, \eta^2 = .08$) or at 12 months ($F(1, 36) = 1.02, p > .05, \eta^2 = .02$). No sex

differences were found for the action words produced at 10 months ($F(1, 36) = .33, p > .05, \eta^2 = .00$) or at 12 months ($F(1, 40) = .003, p > .05, \eta^2 = .00$).

An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) was further carried out for action word production. There was no interaction between time and sex ($F(1, 36) = .07, p > .05, \eta^2 = .002$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of SES (with two levels of high SES and low SES) was carried out for action word production. There was no interaction between time and SES ($F(1, 32) = .13, p > .05, \eta^2 = .004$).

There was no interaction between time and 8 month pointing level ($F(2, 28) = .43, p > .05, \eta^2 = .03$) or between time and 10 month pointing level ($F(2, 28) = 1.48, p > .05, \eta^2 = .09$) or between time and 12 month pointing level ($F(2, 28) = .02, p > .05, \eta^2 = .00$) for action word production.

Pointing level at 8 months did not make a difference on action word production at 10 months as analysis of variance revealed ($F(2,28) = .11, p > .05, \eta^2 = .008$) or at 12 months ($F(2,32) = .24, p > .05, \eta^2 = .01$). Pointing level at 10 months did not make a difference on action word production at 10 months ($F(2, 28) = 1.29, p > .05, \eta^2 = .08$) or at 12 months ($F(2, 32) = 1.65, p > .05, \eta^2 = .09$). Nor did pointing level at 12 months made a significant difference on action word production at 10 months ($F(2, 28) = 1.34, p > .05, \eta^2 = .08$) or at 12 months ($F(2, 32) = 1.28, p > .05, \eta^2 = .07$).

4.5.1.8. Non-action Word Comprehension

We separately investigated 324 non-action word items in the Part I of TIGE-I and carried out the analyses explained below.

The data for non-action word comprehension were normally distributed for 10 months and 12 months ($M = 81.47$, $SD = 54.77$, Skewness = 2.78, Kurtosis = .8; $M = 121.27$, $SD = 55.77$, Skewness = .83, Kurtosis = .18, respectively). As paired sample t test revealed there were statistically significant differences between two time points in the number of non-action words infants comprehended ($t(36) = -6.29$, $p < .001$). Infants comprehended more non-action words when they were 12 months old in comparison to when they were 10 months old. Spearman's rank order correlation further showed that the number of non-action words infants comprehended at 10 months and at 12 months were significantly correlated ($r_s(37) = .81$, $p < .001$). There were no SES related differences in the number of non-action words comprehended at 10 months ($F(1, 32) = .63$, $p > .05$, $\eta^2 = .01$) or at 12 months ($F(1, 35) = .81$, $p > .05$, $\eta^2 = .02$). No sex differences were found in the number of non-action words comprehended at 10 months ($F(1, 36) = .66$, $p > .05$, $\eta^2 = .01$) or at 12 months ($F(1, 39) = 1.36$, $p > .05$, $\eta^2 = .03$).

An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) was further carried out for non-action word comprehension. There was no interaction between time and sex ($F(1, 35) = .02$, $p > .05$, $\eta^2 = .001$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of SES (with two levels of high SES and low SES) was carried out for non-action word comprehension. There was no interaction between time and SES ($F(1, 31) = .04$, $p > .05$, $\eta^2 = .001$).

There was no interaction between time and 8 month pointing level ($F(2, 27) = .54$, $p > .05$, $\eta^2 = .03$) or between time and 10 month pointing level ($F(2, 27) = .21$, $p > .05$, $\eta^2 = .01$) or between time and 12 month pointing level ($F(2, 27) = .28$, $p > .05$, $\eta^2 = .02$) for non action word comprehension.

Pointing level at 8 months did not make a difference on non action word comprehension at 10 months as analysis of variance revealed ($F(2,28) = 1.33, p > .05, \eta^2 = .08$) or at 12 months ($F(2,31) = .63, p > .05, \eta^2 = .03$). Pointing level at 10 months did not make a difference on non action word comprehension at 10 months ($F(2, 28) = .17, p > .05, \eta^2 = .01$) or at 12 months ($F(2, 31) = .29, p > .05, \eta^2 = .01$). Pointing level at 12 months made a marginal significant difference on non action word comprehension at 10 months ($F(2, 28) = 2.69, p = .08, \eta^2 = .16; H = 5.49, p = .06$). Index finger pointing infants at 12 months ($N = 22$) comprehended a mean of 96 ($SD = 59.77$) words whereas whole hand pointing infants ($N = 5$) and non pointing infants ($N = 4$) at the same age comprehended 61.6 ($SD = 35.22$) and 34.25 ($SD = 12.55$) words at 10 months, respectively. As Mann-Whitney U tests revealed there were no significant differences between whole hand pointers and non pointers ($U = 5, p > .05$) or between whole hand pointers and index finger pointers ($U = 36, p > .05$). However, index finger pointers comprehended more words than non pointers ($U = 14, p = .03$).

Pointing level at 12 months made significant difference on non action word comprehension at 12 months ($F(2, 31) = 3.51, p = .04, \eta^2 = .18; H = 6.73, p = .03$). Index finger pointing infants comprehended a mean of 138.8 words ($SD = 57.05$) whereas whole hand pointers comprehended a mean of 87.6 words ($SD = 45.7$) and non pointers comprehended 77.75 words ($SD = 39.2$). As Mann-Whitney U tests revealed there were no significant differences in the number of non action words index finger and whole hand pointers comprehended ($U = 33.5, p > .05$). However there were significant differences in the number of index finger pointers and non pointers ($U = 14, p = .02$) but not between whole hand pointers and non pointers ($U = 9, p > .05$).

4.5.1.9. Non-action Word Production

The data for non-action word production were not normally distributed for 10 months and 12 months ($M = 7.18, SD = 7.8, \text{Skewness} = 5.23, \text{Kurtosis} = 6.7; M = 15.76, SD =$

12.78, Skewness = 5, Kurtosis = 5.28, respectively). Wilcoxon signed test revealed that there were statistically significant differences between two time points in the number of non-action words infants produced ($Z = -4.83, p = .003$). Median number of non-action words produced for infants at 10 months and at 12 months were 5.5 (1.75-10) and 12 (6.75-19). Infants produced more non-action words when they were 12 months old in comparison to when they were 10 months old. Spearman's rank order correlation further showed that the number of non-action words infants produced at 10 months and at 12 months were significantly correlated ($r_s(38) = .78, p < .001$). There were no SES related differences in the number of non-action words produced at 10 months ($F(1, 32) = .16, p > .05, \eta^2 = .00$) or at 12 months. ($F(1, 36) = .79, p > .05, \eta^2 = .02$). Neither were there sex differences at 10 months ($F(1, 36) = .03, p > .05, \eta^2 = .00$) and at 12 months ($F(1, 40) = .11, p > .05, \eta^2 = .00$).

An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) was further carried out for non-action word production. There was no interaction between time and sex ($F(1, 36) = .4, p > .05, \eta^2 = .01$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of SES (with two levels of high SES and low SES) was carried out for non-action word production. There was no interaction between time and SES ($F(1, 32) = 1.31, p > .05, \eta^2 = .03$).

There was no interaction between time and 8 month pointing level ($F(2, 28) = .29, p > .05, \eta^2 = .02$) or between time and 10 month pointing level ($F(2, 28) = .94, p > .05, \eta^2 = .06$). There was a marginally significant interaction between time and 12 month pointing level ($F(2, 28) = 2.94, p = .06, \eta^2 = .17$) for non action word production. Index finger pointing infants at 12 months, produced a mean of 9.23 words ($SD = 1.97$) at 10 months and 17.27 ($SD = 2.81$) at 12 months. Whole hand pointing infants produced a mean of 4 ($SD = 1.42$) words

at 10 months and 4.8 ($SD = 1.8$) at 12 months. Non pointers produced a mean of 6.25 ($SD = 1.75$) words at 10 months and 11.25 ($SD = 3.47$) words at 12 months.

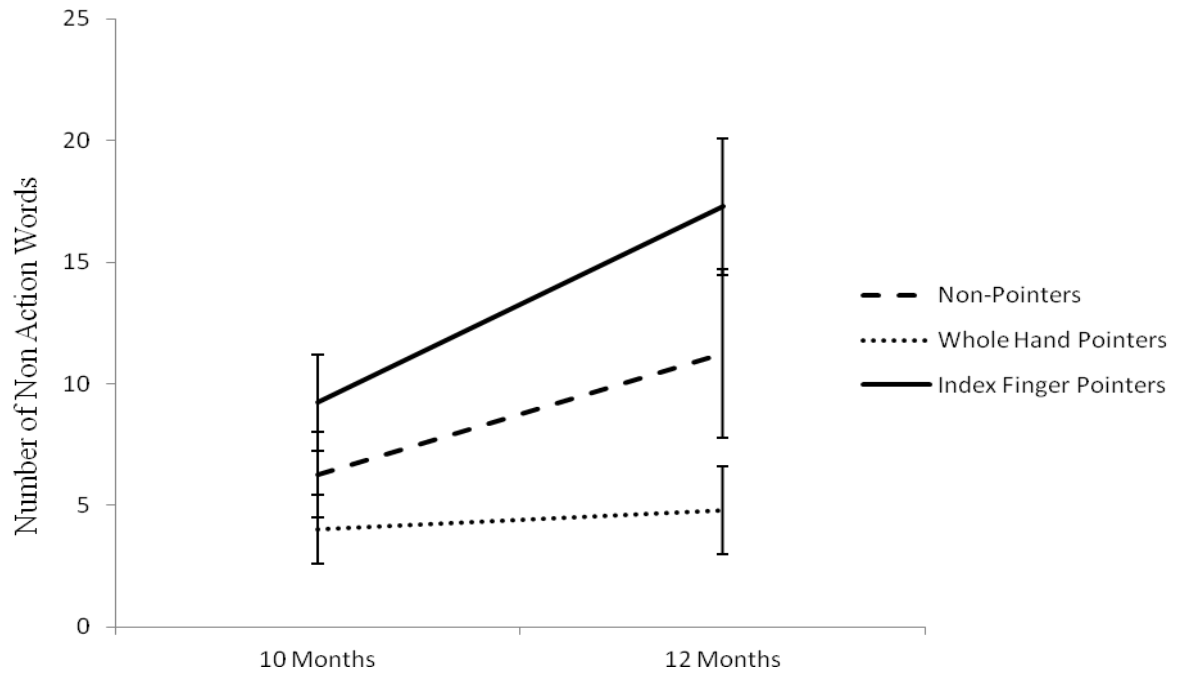


Figure 20. Mean number of non-action words produced in 10 months and 12 months by index-finger pointers, whole hand pointers and non pointers at 12 months. Error bars show ± 1 *SE*.

As Figure 20 shows non-pointing infants and whole hand pointing infants at 12 months did not differ in the number of non-action words they produced between two time points ($F(1,3) = 1.8, p > .05, \eta^2 = .37$), ($F(1,4) = .76, p > .05, \eta^2 = .16$) respectively. However, index-finger pointing infants at 12 months produced more non-action words in time ($F(1, 21) = 33.86, p < .001, \eta^2 = .61$).

Pointing level at 8 months did not make a difference on non action word production at 10 months as analysis of variance revealed ($F(2,28) = 1.26, p > .05, \eta^2 = .08$) or at 12 months ($F(2,32) = .21, p > .05, \eta^2 = .01$). Pointing level at 10 months did not make a difference on non action word production at 10 months ($F(2, 28) = .77, p > .05, \eta^2 = .05$) or at 12 months

($F(2, 32) = .86, p > .05, \eta^2 = .05$). Pointing level at 12 months made no difference on non action word production at 10 months ($F(2, 28) = .93, p > .05, \eta^2 = .06$), yet a marginally significant difference at 12 months ($F(2, 32) = 3, p = .06, \eta^2 = .15; H = 8.03, p = .01$). 12 month whole hand pointers did not differ from non pointers at 12 months in the number of non action words they produced ($U = 4, p > .05$). Non pointers and index finger pointers also did not have a difference in the number of non action words they produced ($U = 34, p > .05$). Index finger pointers produced more words than whole hand pointers at 12 months ($U = 15, p = .005$).

4.5.2. Actions and Gestures

The total data for the section of “Actions and Gestures” (Part II of TIGE) were normally distributed for 10 months and 12 months ($M = 36.18\%$, $SD = 14.54\%$, Skewness = 1.77, Kurtosis = -.37; $M = 51.08\%$, $SD = 18.26\%$, Skewness = .28, Kurtosis = -1.18, respectively). As paired sample t test revealed there were statistically significant differences between two time points in the percentage with which infants did actions and used gestures in total ($t(37) = -5.56, p < .001$). Infants more frequently did actions and used gestures when they were 12 months old in comparison to when they were 10 months old. Spearman’s rank order correlation further showed that the percentages of actions infant did and gestures they used at 10 months and at 12 months were significantly correlated ($r_s(38) = .58, p < .001$). There were no SES related differences in the percentage of actions and gestures infants used at 10 months ($F(1, 35) = .003, p > .05, \eta^2 = .00$) or at 12 months ($F(1, 33) = .82, p > .05, \eta^2 = .02$). Neither were there any sex differences at 10 months ($F(1, 39) = .63, p > .05, \eta^2 = .01$) or at 12 months ($F(1, 37) = .26, p > .05, \eta^2 = .00$).

An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) was further carried out for infants’ “Action and gestures” scores. There was no

interaction between time and sex ($F(1, 36) = 2.09, p > .05, \eta^2 = .05$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of SES (with two levels of high SES and low SES) was carried out for infants' "Action and gestures" scores. There was no interaction between time and SES ($F(1, 32) = 1.08, p > .05, \eta^2 = .03$).

There was a statistically significant interaction between time and 8 month pointing level ($F(2, 28) = 3.56, p = .04, \eta^2 = .2$) for actions and gestures infants used. Index finger pointers used more actions and gestures at 12 months ($M = 61.06\%, SD = 20.3$) than at 10 months ($M = 31.38\%, SD = 9.86$) ($F(1, 4) = 17.07, p = .01, \eta^2 = .81$). Whole hand pointers also used more actions and gestures at 12 months ($M = 55.92\%, SD = 15.48$) than at 10 months ($M = 45.28\%, SD = 15.46$) ($F(1, 10) = 5.61, p = .03, \eta^2 = .36$). Non pointers infants used more actions and gestures at 12 months ($M = 44.72\%, SD = 19.69$) than at 10 months ($M = 35.35\%, SD = 14.2$) ($F(1, 24) = 1.71, p = .03, \eta^2 = .29$). As Figure 21 shows pointing levels at 8 months made a marginal significant effect on the percentage of actions and gestures used at 10 months ($F(2,31) = 2.84, p = .07, \eta^2 = .15; H = 5.18, p = .07$).

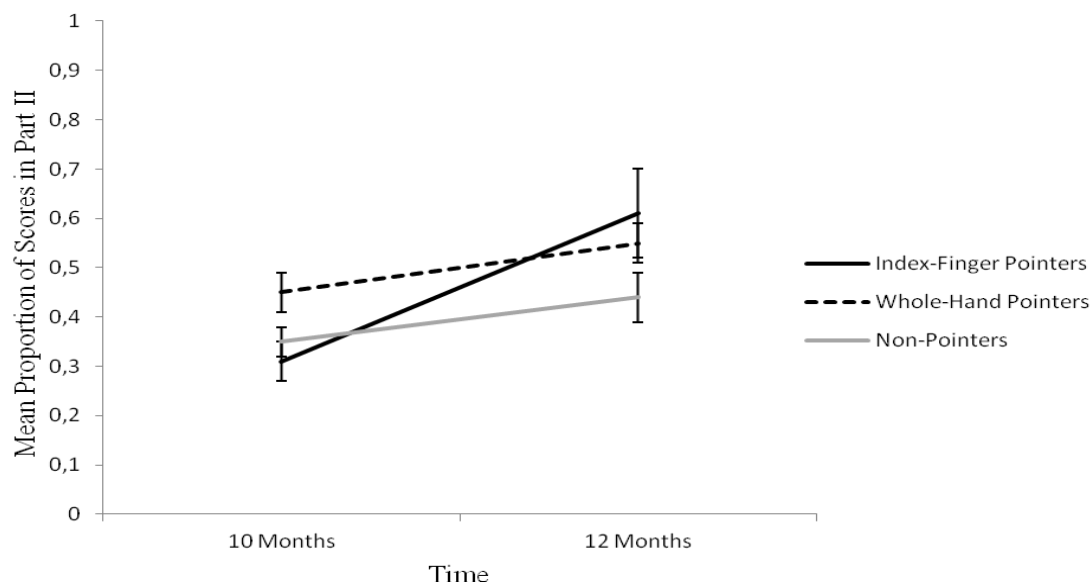


Figure 21. Mean proportion of scores for the section “Actions and Gestures” index-finger pointers, whole hand pointers and non pointer infants at 8 months had at 10 months and at 12 months. Error bars show $\pm 1 SE$.

The differences in action and gesture scores between whole hand pointers and non pointers and between whole hand pointers and index finger pointers at 10 months were marginally significant as Mann Whitney U test revealed ($U = 56, p = .06$; $U = 15, p = .05$, respectively). 8 months old whole hand pointers scored higher in part II of TIGE than index fingers pointers and also than non-pointers. The difference between 8 months old index finger pointers and non pointers ‘actions and gestures’ was not significant ($U = 40, p > .05$). Pointing levels at 8 months did not make an effect on the percentage of actions and gestures used at 12 months ($F(2, 29) = 2.38, p > .05, \eta^2 = .14$).

There was no significant interaction between time and 10 month pointing level ($F(2, 28) = 2.09, p > .05, \eta^2 = .13$) for actions and gestures used. There was no significant interaction between time and 12 month pointing level ($F(2, 28) = 1.76, p > .05, \eta^2 = .11$) for actions and gestures used. Pointing level at 10 months did not make a difference in actions

and gestures used at 10 months ($F(2, 31) = .22, p > .05, \eta^2 = .01$) or at 12 months ($F(2, 29) = 2.23, p > .05, \eta^2 = .13$).

Pointing level at 12 months made a marginally significant difference in actions and gestures used at 10 months ($F(2, 31) = 2.68, p = .08, \eta^2 = .14$). Index finger pointers at 12 months were reported to use more actions and gestures ($M = 40.27\%$, $SD = 15.1$) when 10 months old in comparison to non pointers at 12 months, although only marginally ($M = 23.5\%$, $SD = 6.83$) ($p = .09$). Whole hand pointers used actions and gestures 34.4% ($SD = 7.77$) of the time. There were no significant differences between index finger pointers and whole hand pointers ($p > .05$), and between whole hand pointers and non pointers ($p > .05$).

Pointing level at 12 months made a statistically significant difference on actions and gestures used at 12 months ($F(2, 29) = 6.65, p = .004, \eta^2 = .31$). Index finger pointing infants at 12 months used a mean of 58.33% ($SD = 3.37$) actions and gestures at 12 months, whole hand pointing infants used a mean of 35.87% ($SD = 7.23$) actions and gestures, and non pointing infants used a mean of 34.25% ($SD = 8.08$) actions and gestures. Index finger pointers used more actions and gestures than whole hand pointers ($p = .02$) and than non pointers ($p = .03$). Whole hand pointers and non pointers did not differ from each other in the actions and gestures used ($p > .05$).

4.5.2.1. First Communicative Gestures

The data for the section of “First Communicative Gestures” were normally distributed for 10 months and 12 months ($M = 47.56\%$, $SD = 17.71\%$, Skewness = .19, Kurtosis = .33; $M = 57.51\%$, $SD = 17.33\%$, Skewness = -.89, Kurtosis = .4, respectively). As paired sample t test revealed there were statistically significant differences between two time points in the percentage of gestures infants did ($t(40) = 5.02, p < .001$). Infants more frequently used gestures when they were 12 months old in comparison to when they were 10 months old. Spearman’s rank order correlation further showed that the percentages of gestures infants

produced at 10 months and at 12 months were significantly correlated ($r_s(41) = .66, p < .001$). There were no SES related differences in the percentage of gestures infants used at 10 months ($F(1, 35) = 1.63, p > .05, \eta^2 = .04$). High SES infants were reported to use more gestures at 12 months ($M = 61.75, SD = 17.19, N = 21$) than their low SES agemates ($M = 41.83, SD = 18.12, N = 17$). Yet this difference has just failed to reach significance level ($F(1, 36) = 2.97, p = .09, \eta^2 = .07$). There were no sex difference in the percentage of gestures infants used at 10 months ($F(1, 39) = .13, p > .05, \eta^2 = .01$) or at 12 months ($F(1, 40) = .02, p > .05, \eta^2 = .00$).

An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of sex (with two levels of females and males) was further carried out for first communicative gestures. There was no interaction between time and sex ($F(1, 39) = .53, p > .05, \eta^2 = .01$). An analysis of variance with a within subject factor of time (with two levels of 10 months and 12 months) and a between subject factor of SES (with two levels of high SES and low SES) was carried out for first communicative gestures. There was no interaction between time and SES ($F(1, 35) = .41, p > .05, \eta^2 = .01$).

There was no interaction between time and 8 month pointing level ($F(2, 31) = .12, p > .05, \eta^2 = .008$) or between time and 10 month pointing level ($F(2, 31) = .42, p > .05, \eta^2 = .02$) or between time and 12 month pointing level ($F(2, 31) = .16, p > .05, \eta^2 = .01$) for communicative gestures used.

Pointing level at 8 months did not make a difference in communicative gestures used at 10 months ($F(2, 31) = 2.08, p > .05, \eta^2 = .11$) or at 12 months ($F(2, 32) = 1.76, p > .05, \eta^2 = .1$). Pointing level at 10 months did not make a difference in communicative gestures used at 10 months ($F(2, 31) = .63, p > .05, \eta^2 = .03$) or at 12 months ($F(2, 32) = .39, p > .05, \eta^2 = .02$). Pointing level at 12 months did not make a difference in communicative gestures used at

10 months ($F(2, 31) = 1.36, p > .05, \eta^2 = .08$) or at 12 months ($F(2, 32) = 2.09, p > .05, \eta^2 = .11$).

4.5.3. Summary

There were no differences in “First Signs of Language Understanding” and “Starting to Talk” items between two time points. Sex, SES or pointing levels of infants in any of the time points revealed an interaction.

Infants comprehended more phrases when they were 12 months old in comparison to when they were 10 months old. Neither sex nor SES revealed a significant interaction with time points in the number of phrases comprehended. However, non pointing infants at 8 months comprehended fewer phrases at 12 months than whole hand pointing infants at 8 months. Yet index finger pointings at 8 months did not differ from non-pointing or whole hand pointing infants in the number of phrases they comprehended at 12 months. Pointing level at 10 months did not make a difference in the number of phrases comprehended at 10 months or at 12 months. But when the infants are 12 months old, non pointing infants were reported as understanding fewer phrases at 10 months than index finger pointers, but not than whole hand pointers. There were no differences in the number of phrases 12 month old whole hand pointers and index finger pointers comprehended at 10 months. We could not find a difference between pointing level of 12 month old infants in the number of phrases they comprehended at 12 months.

12 month old infants comprehended more vocabulary than when they were 10 months. However, no interaction between sex and time or between SES and time was found for the number of vocabulary comprehended. Pointing level of infants at 8 months or at 10 months did not make a difference in the number of vocabulary they comprehended at 10 months or at 12 months. Yet we found a slightly marginal effect of pointing level at 12 months on the number of vocabulary comprehended at 10 months. Index finger pointing infants at 12 months

were reported to comprehend more vocabulary 10 months than non pointing infants at 12 months, but not than whole hand pointing infants at 12 months. We also found a marginally significant effect of pointing level at 12 months on the number of vocabulary comprehended at 12 months. Index finger pointing infants at 12 months comprehended more vocabulary at 12 months than both non-pointing, but again not than whole hand pointing infants at 12 months.

12 month old infants produced more vocabulary than when they were 10 months. However, no interaction between sex and time or between SES and time was found for the number of vocabulary produced. There were no interactions revealed between pointing levels at 8 months and time or between pointing levels at 10 months and time, or between pointing levels at 12 months and time. However, when we treated whole hand pointers and non pointers as one group (i.e. non-index-finger pointers) and index finger pointers as another, we found a marginally significant interaction between pointing levels at 12 months and time. This aggregation could be justified considering the unequal sample size of groups showing different shapes of pointing or no-pointing behavior at all ($N = 22$ for index finger pointing, $N = 5$ for whole hand pointing, and $N = 4$ for non pointing infants at 12 months). Non-index finger pointing infants at 12 months did not show a difference in the vocabulary they produced at 10 months ($M = 5$, $SD = 3.31$) and 12 months ($M = 8.44$, $SD = 6.91$). But index finger pointing infants produced more vocabulary by time (at 10 months $M = 10.73$, $SD = 11.67$, at 12 months $M = 19.55$, $SD = 15.07$). Index finger pointing infants at 12 months produced more vocabulary at 12 months than non-index finger pointing infants at 12 months ($F(1,33) = 5.37$, $p = .002$, $\eta^2 = .14$). However there were no differences between 12 month old index-finger pointers and non-index finger pointer in the number of vocabulary they were reported to produce at 10 months ($F(1,29) = 2.05$, $p = .16$, $\eta^2 = .06$).

We further separately analyzed the number of action words and non-action words comprehended and produced. 12 month old infants comprehended more action words than when they were 10 months old. We could not find any interaction between sex and time or between SES and time. There was no interaction between pointing level of infants at 8 months and time, or between pointing level at 12 months and time. Yet we found a marginally significant interaction between pointing level at 10 months and time for the number of action words comprehended. Index finger pointers and whole hand pointers at 10 months were reported as comprehending more action words by time; however there was no significant change for non pointing infants at 10 months in the number of action words they comprehended in time.

12 month old infants also produced more action words than when they were 10 months old, yet there were no interactions between sex and time, SES and time, and pointing levels in any of the time points and time.

For non-action words comprehended even though there was a significantly increasing trend over the time we could not find any interactions between sex and time, SES and time and pointing levels in any of the time points and time. However, when we carried out separate one way analysis of variance we found that pointing level at 12 months made a marginal significant difference on non action word comprehension at 10 months. We also found a marginal effect of pointing level at 12 months on non action word comprehension at 12 months. In other words 12 month old index finger pointers comprehended more non-action words than non-pointers, but not than whole hand pointers at 10 months and also at 12 months.

For non-action words produced even though there was also a significantly increasing trend over the time we could not find any interactions between sex and time, and SES and time. There was no interaction between pointing levels at 8 months and time and pointing

levels at 10 months and time. However, we found a marginally significant interaction between pointing levels at 12 months and time. Index finger pointing infants at 12 months produced more non action words in time; yet whole hand pointing and non pointing infants at 12 months did not differ in the number of non-action words they produced between two time points. Index finger pointers at 12 months were also found to be producing more non action words than whole hand pointers, but not than non pointers.

12 month old infants more frequently did actions and used gestures when they were 12 months old in comparison to when they were 10 months old. However, there were no interactions between sex and time, SES and time for actions and gestures utilized by infants in two different time points. 8 month old whole hand pointers more frequently displayed actions and gestures at 10 months than index finger pointers and non-pointers at 8 months. However there were no differences in 8 month old whole hand pointers, index finger pointers and non-pointers' percentages of actions and gestures at 12 months. No significant interaction between pointing levels at 10 months and time, and between pointing levels at 12 months and time was found for actions and gestures displayed by the infants. However, there was a marginally significant difference between 12 month old index finger pointers and non pointers in the percentage of actions and gestures they used at 10 months. 12 month old index finger pointers were reported as using more actions and gestures at 10 months than non pointers, but not than whole hand pointers. 12 month old index finger pointers were also found to be more frequently using actions and gestures than whole hand pointers and than non pointers at 12 months.

12 month old infants also more frequently produced communicative gestures than when they were 10 months old, yet there were no interactions between sex and time, SES and time, and pointing levels in any of the time points and time for the percentage of communicative gestures.

4.5.4. Linear Regression Analyses for Vocabulary Development

4.5.4.1. in Relation with Maternal Pointing

We carried out simple regression analyses between TIGE variables of our interest and maternal index finger pointing frequency to assess whether there is a predictive effect of any maternal gestural input at any time points of vocabulary development of infants. Maternal index finger pointing frequency at 8 months predicted the percentage of non-action words comprehended by infants at 10 months ($\beta = .35$, $t(34) = 2.2$, $p < .05$) explaining a significant proportion of variance in the percentage of non-action words comprehended at 10 months ($R^2 = .12$, $F(1, 34) = 4.85$, $p < .05$). Maternal index finger pointing frequency at 8 months has just failed to reach significance in predicting percentage of non-action words produced by infants at 10 months ($\beta = .20$, $t(34) = 1.76$, $p = .08$) explaining only a marginally significant proportion of variance in the percentage of non-action words produced at 10 months ($R^2 = .08$, $F(1, 34) = 3.1$, $p = .08$). Maternal index finger pointing frequency at 8 months also significantly predicted action words comprehended at 12 months ($\beta = .42$, $t(34) = 2.67$, $p = .01$) explaining a significant proportion of variance in the percentage of action words comprehended at 12 months ($R^2 = .17$, $F(1, 34) = 7.15$, $p = .01$).

Maternal index finger pointing frequency at 10 months has just approached significance in predicting action words comprehended by infants at 10 months ($\beta = .3$, $t(34) = 1.82$, $p = .07$) explaining only a marginally significant proportion of variance in the percentage of action words comprehended at 10 months ($R^2 = .09$, $F(1, 34) = 3.31$, $p = .07$). We found a significant predictive effect of maternal index finger pointing frequency at 10 months for action word production at 10 months ($\beta = .34$, $t(34) = 2.09$, $p = .04$) explaining a significant proportion of variance in the percentage of action words produced at 10 months ($R^2 = .11$, $F(1, 34) = 4.38$, $p = .04$). Maternal index finger pointing frequency at 10 months

significantly predicted non-action words comprehended ($\beta = .35$, $t(34) = 2.19$, $p = .03$) and produced ($\beta = .35$, $t(34) = 2.16$, $p = .03$) at 10 months. It explained a significant proportion of variance in the percentage of non action words comprehended ($R^2 = .12$, $F(1, 34) = 4.82$, $p = .03$) and produced at 10 months ($R^2 = .12$, $F(1, 34) = 4.7$, $p = .03$).

4.5.4.2. in Relation with Infant Pointing

Infant index finger pointing frequency at 8 months significantly predicted the number of phrases infants comprehended at 10 months ($\beta = .32$, $t(34) = 1.97$, $p = .05$) explaining significant proportion of variance in the number of phrases infants comprehended at 10 months ($R^2 = .10$, $F(1, 34) = 3.88$, $p = .05$). Infant index finger pointing frequency at 8 months also significantly predicted the number of action words infants comprehended ($\beta = .35$, $t(34) = 2.14$, $p = .03$) and produced ($\beta = .50$, $t(34) = 3.34$, $p = .002$) at 10 months; explaining significant proportion of variance in the number of action words infants comprehended ($R^2 = .12$, $F(1, 34) = 4.6$, $p = .03$) and produced ($R^2 = .25$, $F(1, 34) = 11.15$, $p = .002$) at 10 months. Infant index finger pointing frequency at 8 months further significantly predicted the number of non action words infants comprehended ($\beta = .39$, $t(34) = 2.47$, $p = .01$) and produced ($\beta = .49$, $t(34) = 3.28$, $p = .002$) at 10 months; explaining significant proportion of variance in the number of non action words infants comprehended ($R^2 = .15$, $F(1, 34) = 6.14$, $p = .01$) and produced ($R^2 = .24$, $F(1, 34) = 10.76$, $p = .002$). At 10 months. Communicative gestures produced by infants at 10 months were also predicted from index finger pointing frequency of infants at 8 months ($\beta = .43$, $t(34) = 2.74$, $p = .01$), explaining significant proportion of variance in the percentage of communicative gestures infants used at 10 months ($R^2 = .18$, $F(1, 34) = 7.54$, $p = .01$). Index finger pointing at 8 months further predicted the scores the infants received from Part II section of TIGE-1 ($\beta =$

.56, $t(34) = 3.93$, $p = .00$), explaining significant proportion of variance in the percentage of actions and gestures infants used ($R^2 = .31$, $F(1, 34) = 15.48$, $p = .00$).

Infant index finger pointing frequency at 8 months significantly predicted the number of vocabulary infants comprehended at 12 months ($\beta = .38$, $t(34) = 2.37$, $p = .02$), explaining significant proportion of variance in the number of vocabulary infants comprehended at 12 months ($R^2 = .14$, $F(1, 34) = 5.63$, $p = .02$). When we looked at the action words and non-action words separately we further found that index finger pointing frequency at 8 months significantly predicted the percentage of actions words infants comprehended ($\beta = .33$, $t(34) = 2.02$, $p = .05$) and the percentage of non-action words infants comprehended ($\beta = .30$, $t(34) = 1.84$, $p = .07$) at 12 months, explaining significant proportion of variance in the percentage of action and non-action words infants comprehended at 12 months ($R^2 = .11$, $F(1, 34) = 4.11$, $p = .05$; $R^2 = .09$, $F(1, 34) = 3.93$, $p = .07$, respectively).

Infant index pointer frequency at 12 months significantly predicted the percentage of action words infants produced at 12 months ($\beta = .39$, $t(34) = 2.44$, $p = .02$), explaining significant proportion of variance in the percentage of action words infants produced at 12 months ($R^2 = .15$, $F(1, 34) = 5.95$, $p = .02$). Infant index finger pointing frequency at 12 months significantly predicted the percentage of non action words infants comprehended at 12 months ($\beta = .31$, $t(34) = 1.89$, $p = .06$), explaining significant proportion of variance in the percentage of non action words infants comprehended at 12 months ($R^2 = .09$, $F(1, 34) = 3.6$, $p = .06$).

4.5.4.3. in Relation with Point Following Skills

Correct look percentages of infants at 8 months significantly predicted infants' scores in Part II section of TIGE I ($\beta = .36$, $t(34) = 2.23$, $p = .03$) explaining significant proportion of variance in the percentage of actions and gestures displayed at 10 months ($R^2 = .13$, $F(1,$

34) = 4.98, $p = .03$). Infants' correct look percentages at 8 months have approached to significance in predicting total number of vocabulary infants comprehended at 12 months ($\beta = .31$, $t(34) = 1.91$, $p = .06$) explaining a marginally significant proportion of variance in the number of vocabulary comprehended at 12 months ($R^2 = .10$, $F(1, 34) = 3.66$, $p = .06$).

Correct look percentages of infants at 10 months significantly predicted the number of phrases infants comprehended at 10 months ($\beta = .35$, $t(34) = 2.14$, $p = .03$) explaining significant proportion of variance in the number of phrases infants comprehended at 10 months ($R^2 = .12$, $F(1, 34) = 4.62$, $p = .03$). It further predicted the percentage of action words infants comprehended at 10 months ($\beta = .33$, $t(34) = 2.03$, $p = .05$) and action words infants produced at 10 months ($\beta = .42$, $t(34) = 2.69$, $p = .01$); explaining significant proportion of variance in the percentage of action words infants comprehended ($R^2 = .11$, $F(1, 34) = 4.15$, $p = .05$) and produced ($R^2 = .18$, $F(1, 34) = 7.26$, $p = .01$) at 10 months.

Correct look percentages of infants at 10 months also significantly predicted the percentage of non-action words infants comprehended ($\beta = .43$, $t(34) = 2.74$, $p = .01$) and produced ($\beta = .42$, $t(34) = 2.69$, $p = .01$) at 10 months; explaining significant proportion of variance in the percentage of non action words infants comprehended ($R^2 = .18$, $F(1, 34) = 7.51$, $p = .01$) and produced ($R^2 = .18$, $F(1, 34) = 7.25$, $p = .01$). Further it predicted the communicative gestures infants used at 10 months ($\beta = .49$, $t(34) = 3.23$, $p = .003$) and at 12 months ($\beta = .53$, $t(34) = 3.68$, $p = .001$); explaining significant proportion of variance in the percentage of communicative gestures infants used at 10 months ($R^2 = .24$, $F(1, 34) = 10.45$, $p = .003$) and at 12 months ($R^2 = .29$, $F(1, 34) = 13.54$, $p = .001$)

Correct look percentages of infants 12 months significantly predicted the number of phrases infants comprehended at 12 months ($\beta = .43$, $t(34) = 2.78$, $p = .009$) explaining significant proportion of variance in the number of phrases infants comprehended at 12

months ($R^2 = .19$, $F(1, 34) = 7.76$, $p = .009$). Correct look percentages of infants 12 months further predicted the total number vocabulary comprehended ($\beta = .39$, $t(34) = 2.48$, $p = .01$) and produced ($\beta = .34$, $t(34) = 2.09$, $p = .04$) at 12 months; explaining significant proportion of variance in the number of vocabulary infants comprehended ($R^2 = .15$, $F(1, 34) = 6.19$, $p = .01$) and produced ($R^2 = .11$, $F(1, 34) = 4.39$, $p = .04$).

When we looked at the action words and non-action words separately we again found a predictive power of correct look percentages of infants at 12 months for action words comprehended ($\beta = .37$, $t(34) = 2.3$, $p = .02$) and produced ($\beta = .43$, $t(34) = 2.74$, $p = .01$) at 12 months; explaining significant proportion of variance in the percentage of actions infants comprehended ($R^2 = .13$, $F(1, 34) = 5.3$, $p = .02$) and produced ($R^2 = .18$, $F(1, 34) = 7.51$, $p = .01$) at 12 months. Correct look percentages of infants at 12 months also predicted the percentage of non-action words comprehended at 12 months ($\beta = .36$, $t(34) = 2.24$, $p = .03$), explaining significant proportion of variance in the number of non-action words infants comprehended ($R^2 = .13$, $F(1, 34) = 5.05$, $p = .03$). It only marginally predicted non-action word production ($\beta = .29$, $t(34) = 1.77$, $p = .08$), explaining marginally significant proportion of variance in the number of non-action words infants produced at 12 months ($R^2 = .08$, $F(1, 34) = 3.14$, $p = .08$).

Correct look percentages of infants 12 months significantly predicted the percentage of communicative gestures infants used at 12 months ($\beta = .39$, $t(34) = 2.47$, $p = .01$) explaining significant proportion of variance in the percentage of gestures infants were reported to use at 12 months ($R^2 = .15$, $F(1, 34) = 6.1$, $p = .01$).

4.5.4.4. Hierarchical Multiple Regression

Only the variables that were distributed normally were added to the regression models. To test whether point following performances of infants could be found to predict the

percentage of action words comprehended at 12 months above and beyond maternal index finger pointing frequencies when controlled for SES and sex, a hierarchical multiple regression analysis was performed. Tests for multicollinearity indicated that a very low level of multicollinearity was present. Variance inflation factors were 1.27 for SES and 1.19 for sex. Variance inflation factors for maternal index pointing frequencies were 2.06 for 8 months, 1.97 for 10 months, 2.15 for 12 months and variance inflation factors for correct look percentages of infants were 1.67 for 10 months and 1.18 for 12 months. SES and sex were the first variables entered, followed by maternal index finger pointing frequency at 8 months, 10 months and 12 months which were further followed by percentage of correct look behaviors of infants at 10 months and at 12 months.

When SES and sex were entered first, they did not significantly predict the percentage of action words infants comprehended at 12 months ($F(2, 27) = 2.42, p = .1$). When maternal index finger pointing frequencies were entered, the model significantly predicted the percentage of action words infants comprehended at 12 months ($F(5, 24) = 3.21, p = .02$). As table 9 indicates the addition of the maternal pointing frequencies significantly improved the model's predictive capacity, explaining additional 24% percentage of variance in the number of action words infants comprehended at 12 months (R^2 change = .24. $F(3, 24) = 3.33, p = .03$). When point following performances of infants were further entered, the predictive capacity of the model significantly increased, explaining additional 14% percentage of variance in the number of action words infants comprehended at 12 months (R^2 change = .14. $F(2, 22) = 3.44, p = .05$). The final model significantly predicted the percentage of action words infants comprehended at 12 months ($F(7, 22) = 3.75, p = .008$).

Table 9. *Summary of Hierarchical Regression Analysis for Variables Predicting the Percentage of Action Words Infants Comprehended at 12 Months*

	β	t	$Sig.$	R^2	ΔR^2	F for ΔR^2
Step 1				.08	.15	2.42
SES	-.06	-2.05*	.05			
Sex	-.37	-.34	.73			
Step 2				.27	.24	3.33*
Maternal Pointing Freq at 8 M	.55	2.84**	.009			
Maternal Pointing Freq at 10 M	-.08	-.38	.7			
Maternal Pointing Freq at 12 M	-.35	-1.72	.09			
Step 3				.39	.14	3.44*
Correct Looks at 10 M	.04	.18	.85			
Correct Looks at 12 M	.4	2.61*	.01			

* $p < .05$, ** $p < .01$

We also carried out another hierarchical multiple regression to see whether point following performances of infants could be found to predict the percentage of non-action words comprehended at 12 months above and beyond maternal index finger pointing frequencies when controlled for SES and sex. SES and sex were the first variables entered, followed by maternal index finger pointing frequency at 8 months, 10 months and 12 months which were further followed by percentage of correct look behaviors of infants at 10 months and at 12 months. When SES and sex were entered first, they did not significantly predict the

percentage of non action words infants comprehended at 12 months ($F(2, 27) = 1.16, p = .32$). When maternal index finger pointing frequencies were entered, the model again did not significantly predict the percentage of non action words infants comprehended at 12 months ($F(5, 24) = 1.33, p = .28$). As table 11 indicates the addition of the maternal pointing frequencies explained additional 13% percentage of variance in the number of non-action words infants comprehended at 12 months, but this was not significant (R^2 change = .13. $F(3, 24) = 1.41, p = .26$). When point following performances of infants were further entered, the predictive capacity of the model did not also significantly increase, explaining additional 10% percentage of variance in the number of non action words infants comprehended at 12 months (R^2 change = .1. $F(2, 22) = 1.64, p = .21$). The final model did not predict the percentage of non-action words 12 months old infants comprehended ($F(7, 22) = 1.47, p = .22$).

Table 10. *Summary of Hierarchical Regression Analysis for Variables Predicting the Percentage of Non-Action Words Infants Comprehended at 12 Months*

	β	t	$Sig.$	R^2	ΔR^2	F for ΔR^2
Step 1				.01	.08	.32
SES	-.03	-.15	.87			
Sex	-.27	-1.4	.15			
Step 2				.05	.13	.26
Maternal Pointing Freq at 8 M	.1	.48	.63			
Maternal Pointing Freq at 10 M	.25	1.01	.32			
Maternal Pointing Freq at 12 M	-.47	-2.04	.05*			
Step 3				.1	.1	.21
Correct Looks at 10 M	.05	.24	.8			
Correct Looks at 12 M	.34	1.78	.08			

* $p < .05$

We also carried another hierarchical multiple regression to see whether point following performances of infants could be found to predict the percentage of communicative gestures infants used at 12 months above and beyond maternal index finger pointing frequencies when controlled for SES and sex. SES and sex were the first variables entered, followed by maternal index finger pointing frequency at 8 months, 10 months and 12 months which were further followed by percentage of correct look behaviors of infants at 10 months and at 12 months. When SES and sex were entered first, they did not significantly predict the

percentage of communicative gestures infants used at 12 months ($F(2, 27) = .94, p = .4$). When maternal index finger pointing frequencies were entered, the model did not significantly predict the percentage of communicative gestures infants used at 12 months ($F(5, 24) = 1.39, p = .26$). As table 11 indicates the addition of the maternal pointing frequencies did not significantly improve the model's predictive capacity but explained an additional 16% percentage of variance in the percentage of gestures infants used at 12 months (R^2 change = .16, $F(3, 24) = 1.65, p = .2$). When point following performances of infants were further entered, the predictive capacity of the model this time significantly increased, explaining additional 20% percentage of variance in the percentage of gestures infants displayed at 12 months (R^2 change = .20, $F(2, 22) = 3.83, p = .03$). The final model has approached to significance in predicting the percentage of communicative gestures infants displayed at 12 months ($F(7, 22) = 2.32, p = .06$).

Table 11. *Summary of Hierarchical Regression Analysis for Variables Predicting the Percentage of Communicative Gestures Infants Displayed at 12 Months*

	β	T	$Sig.$	R^2	ΔR^2	F for ΔR^2
Step 1				-.004	.06	.94
SES	.24	1.28	.21			
Sex	.04	.22	.82			
Step 2				.06	.16	1.65
Maternal Pointing Freq at 8 M	.29	1.33	.19			
Maternal Pointing Freq at 10 M	.002	.006	.99			
Maternal Pointing Freq at 12 M	-.43	-1.85	.07			
Step 3				.24	.2	3.83*
Correct Looks at 10 M	.4	1.95	.06			
Correct Looks at 12 M	.33	1.89	.07			

* $p < .05$, ** $p < .01$

CHAPTER 5

DISCUSSION

5.1. Infant Pointing Production in Decorated Room

Some infants as young as 8 month olds were capable of pointing by extending their index fingers. Seven infants, out of 35, showed index finger pointing during the decorated room procedure at 8 months; the maximum number of index finger pointing during the five minute recording in the decorated room was two (when we treated the infant with 21 index finger pointings as an outlier), with a mean of .24 ($SD = .55$). The number of index finger pointings displayed by the infants increased to 2.42 ($SD = 5.7$) at 10 months. At 10 months there were 14 infants out of 35 pointing with index finger. When the infants were 12 months old, 26 infants showed index finger pointing with a mean of 5.11 ($SD = 5.97$). Not all differences between the index finger frequencies of infants in three different time points were statistically significant, though. There were only significant differences in the number of index pointings between 8 months and 12 months, and between 10 months and 12 months, probably because index finger pointing becomes only robust by the time infants are a year old (Liszkowski, Carpenter, & Tomasello, 2007; Callaghan, Moll, Rakoczy, Warneken, Liszkowski, Behne, & Tomasello, 2011). However, there were still nine infants (25.71% of the infants) who did not display any index finger pointing in the decorated room at 12 months.

We expected that low SES infants were going to display fewer index finger pointings than their high SES agemates, but such a difference was not observed. We also could not find any SES-related differences in the onset of index finger pointing. Sex was also construed as another variable that might be associated with differences in index finger pointing onset and frequency. Since it is shown female sex is associated with a faster rate of lexical development (Hyde & Linn, 1988; Huttenlocher, Haight, Bryk, Seltzer, & Lyon, 1991; Berglund, Eriksson, & Westerlund, 2005), we hypothesized such a sex effect for the domain of preverbal

communication as well, in line with the findings of Butterworth and Morisette (1996). Yet, to the contrary to our hypothesis there was no effect of sex in index finger pointing frequency or onset at any of the three time points. Matthews et al. (2012) also could not find any sex differences in pointing frequency or type of pointing in 9 month- and 11-month-old infants. Özcalışkan and Goldin-Meadow (2010) further reported that although females utilized supplementary gesture-speech combinations earlier than males in their longitudinally recorded 14 to 22 months olds, there were no sex differences in the frequency or the types of gestures used.

Even though there were no SES or sex related differences in the frequency of index finger pointing, we found that the infants who showed index finger pointing at 8 months more frequently showed index finger pointing at 10 months. And infants who showed index finger pointing at 10 months more frequently displayed index finger pointing at 12 months.

As it is the case for index finger pointing frequency, we also found an increasing trend over the number of whole hand pointing frequency between the time infants were 8 months and 12 months. Finding that the difference in the frequency of pointing behaviors (whether it is index finger or whole hand pointing) is not significant between 8 months and 10 months, but is so between 8 months and 12 months strengthens our observation and the findings of previous research that pointing behaviors are not robustly exercised until the time that the infants are 12 months old. Future studies should design longitudinal observational procedures to follow infants' pointing frequencies after their first birthday. We still do not know whether infants exercise pointing more frequently as they get older after their first birthday or whether there is a peak point in pointing frequency and a decline after a certain point – in line with the interrogative motive of pointing (Csibra & Gergely, 2006, and for a review on the controversy regarding the motivation behind infant pointing see Southgate, Van Maanen, & Csibra, 2007).

Another hypothesis about the ontogeny of index finger pointing production was that whole hand pointing was a precursor of index finger pointing. We found that whereas 7 infants showed index finger pointing at 8 months, 12 infants out of 35 displayed only whole hand pointings at the same time point. Apparently whole hand pointing onset is earlier than index finger pointing. At 10 months half of the whole hand pointers were still not utilizing index finger pointing. Yet at 12 months the majority of whole hand pointers learned to interchangeably use pointing with their index fingers and whole hands. However, when we examined whether the infants who were already pointing with their whole hands were the ones who started to point with their index fingers earlier than the others, we could not confirm our hypothesis that whole hand pointing is a necessary precursor of index finger pointing. We also could not find an effect of whole hand pointing display (whether infants pointed with their whole hands or not) on the index finger pointing frequency in subsequent time points. There were also no correlations between index finger pointing frequency and whole hand pointing frequency in any of the time points.

Future studies should include the infants younger than 8 months to assess the possible role of whole hand pointing in the emergence of index finger pointing. In our data, neither emergence nor frequency of whole hand pointing exerts any influence on the onset of index finger pointing. Rather the two kinds of pointing co-exist in the preverbal communication repertoire of infants. Even in adult communication we are not solely dependent on index finger pointing, rather we also point with our whole hands, with our chins or with our heads (Kita, 2003).

With the finding that whole hand pointing frequency did not explain the onset or the frequency of subsequent index finger pointing, one could claim that this finding is likely to rule out the hypothesis that index finger pointing is developed out of ritualized reaching gestures of infants. Even though we made sure that the items in the decorated room were out

of reach of infants and we clearly instructed mothers not to touch any of the items, we must acknowledge that the coding of whole hand pointing led to some disputes between the coders. The inter-rater reliability of gestures was high enough (87% between the two coders) for us to carry out the statistical analyses, yet we still have doubts about whether the whole hand pointings especially of the infants were intended as points to an object and not as reaches toward an object. Decorated room elicits not only pointing behaviors from the dyads, but iconic gestures (i.e. a mother showing how the windmill moves by moving her fingers in circular fashion) and ritualistic gestures (i.e. waving goodbye to one item when approaching to another item or reaching to one item to get the infant's attention). Given this variety of gestures, we should admit that whole hand pointing might be confounded with reaching behavior. Future research should put the infant gestural acts into context by through codings of vocalizations and facial expressions accompanying gestures produced by the infants. For example Liszkowski (2014) recently showed that vocalizations accompanying infant pointings reveal different social intentions infants had while pointing imperatively, declaratively, or interrogatively.

5.2. Caregiver Pointing Production in Decorated Room

There were no differences in the frequency of index finger pointing of mothers across the three time points. Caregivers showed a consistent pattern in the number of pointings they displayed. Although they occasionally used their whole hands to point to items in the room, this was rather seldom. Mothers utilized index finger pointings a lot more frequently than they used whole hand pointings. Mean of whole hand pointings in three time points were .59 ($SD = .11$), .31 ($SD = .07$), and .49 ($SD = .1$), respectively whereas mean of index finger pointings were 14.33 ($SD = 2.86$), 17.25 ($SD = 3.5$) and 16 ($SD = 3.24$) respectively. Why they dominantly used their index fingers, even though they could have just pointed by other means is not known to us given that adults also point by exploiting other body parts. Although no

research to date has systematically investigated declarative pointing behaviors of adults in different contexts with different recipients, if the use of predominant index finger pointing is a way of declarative exaggeration exploited by the adult specifically for the infant (see natural pedagogy theory of Csibra & Gergeley, 2009) more frequent use of index finger pointing by mothers (than their whole hand pointings) in our data might be reflecting a tendency of adults to explicitly tailor the pointing act for the infant. Likely, one might expect that in adult to adult communication there is more variance in the type of pointings observed. However, no research has assessed that before.

We hypothesized that mothers with higher education would point more frequently than mothers with eight years or fewer years of education. We also expected that this difference in maternal pointing frequencies would translate to preverbal communicatory skills of infants. Only one research to date (Rowe & Goldin-Meadow, 2009a) found the effect of SES on infant and maternal gesture use in daily interactions between the dyads when the infants were 14 months old. Yet one should note that Rowe and Goldin-Meadow (2009a) treated SES as a composite of family income and maternal education, and gesture use was defined as the number of different meanings conveyed by the gesture. We could not find SES related difference in the number of maternal pointings. One reason might be to do with the multifaceted nature of SES variable.

SES is not only constituted by maternal education but also by the education of the other household members and income of the family (Baydar, Küntay, Yagmurlu, Aydemir, Çankaya, Gökşen, & Cemalcılar, in press). Hence we might have overlooked the important aspects of SES while treating it as only a factor of maternal education. Future research should operationalize SES as a composite of variables, not only as maternal education. Furthermore we analyzed only the frequency of pointing gestures, we did not take into account the different entities pointings of either parties refer to. It is also likely that decorated room elicits

equal amounts of pointings from both groups since it is specifically designed to evoke index finger pointing. Future research should utilize naturalistic interactions to investigate the effect of SES on gestural repertoire.

All mothers used index finger pointings in the decorated room, and their frequency of pointing partly explained the differences between infants who displayed pointing and others who did not. Maternal index finger pointing frequency at 8 months predicted infant pointing frequency at 10 months. And maternal index finger pointing frequency at 10 months predicted infant pointing frequency, and infant whole hand pointing frequency particularly, at the same time point. Maternal index finger pointing frequency did not predict the index finger behavior of infants alone in any of the time points. The finding that frequency of maternal index finger pointing is not predictive of frequency of infant index pointing supports Matthews et al. (2012) findings, yet contradicts with the findings of Liszkowski and Tomasello (2011).

Yet we should note that correlations we found between already index pointing infants' frequency at 8 months and mothers' index finger pointings at 10 months might suggest that the direction of the relationship between infant pointing and maternal pointing might be different than traditionally believed. Infants who were pointing already with their index fingers or the ones who already started pointing with their index fingers might be driving their mothers to also frequently engage in pointing behavior.

Given that there was no clear transfer of maternal pointing frequency to preverbal communicatory skills of infants as we expected, we still do not know exactly why there are differences in the emergence and in the frequency of early index finger pointing production. One possibility is that SES does not influence the quantity of the maternal gestures but the quality of them. Pointing behaviors of mothers were not produced in isolation, but with

linguistic input. Future research should investigate differences in maternal gestural input by looking at the language features accompanying them.

Future research should also explore individual differences in preverbal communication by studying younger infants. For example assessing the duration and the quality of joint attention episodes of infants with their mothers might be a precursor for the emergence of pointing behavior. Ritualistic gestures (i.e. reaching, showing by holding), not only pointings, utilized by mothers in their daily interactions with infants should be a focus of future research in understanding individual differences in preverbal communication.

Prospective studies utilizing the decorated room paradigm or similar semi-observational contexts to elicit pointing behavior should also control what kind of items to include in the setting. For example out of 19 items in the decorated room, there were such items as a small coffee cup, a windmill, and a ball which make it easier for mothers to use iconic gestures as they view them with their infants. Items like a coffee cup or a windmill make it easier for mothers to engage in iconic gestures and however such items as a flashing bike reflector or a lantern is not readily manipulatable objects in everyday life, and are more likely to elicit pointing, rather than iconic gestures . Puccini and his colleagues (2010) pointed out that the type of activities engaged by mothers and infants shape the communication. They compared the linguistic and gestural communication of mother-infant dyads in a free play and a decorated room context with the same number of objects, showing that where object manipulation was possible mothers predominantly used proximal gestures such as showing by holding or acting on the object, whereas where object manipulation was not possible mothers exploited pointing more frequently. However, not only type of shared activity but also the type of objects utilized in these semi-observational contexts might shape communication.

5.3. Point Following Skills of Infants

There was a positively increasing trend over time in the percentage of correct look behaviors of infants during point following. Infants also showed an exact opposite trend in their percentage of no-look behaviors. However, surprisingly infants at 8 months showed fewer incorrect look behaviors than when they were 10 months old and 12 months old (yet this does not mean that infants perform better at 8 months than at 10 months or than at 12 months, infants' non-look behaviors were 78.2% at 8 months whereas their incorrect looks were 11.1%). To follow up with this finding, we separately looked at the trials in which the items were placed within the visual field and outside of the visual field (behind) of the infants.

Infants looked correctly to the items more frequently by time, but only when the items were in their visual field. There was no effect of time for correct look behaviors for the items outside of their visual field. In other words, correct look behaviors of infants increased in time for peripheral items, but there was no improvement in infants' looking performance for the items that were behind of them. Furthermore, infants' correct looks for the peripheral items were always higher in percentage, except when they were 8 months old, where their performance was close to the floor for every item pointed.

With regard to incorrect look behaviors of infants, there was a main effect of time for trials with behind items, and not for trials with peripheral items. In other terms, infants more frequently looked at another target other than the one pointed in the trials where the pointed items were behind their visual fields by time.

These findings, even though counterintuitive at first sight given that incorrect look behaviors of infants for behind items were increasing in percentage by the time the infants were 12 months old, nevertheless show infants learn to follow the pointing acts of others, although not always successfully. If we consider the below chance performance of infants in correctly following the pointing act to its target at 8 months, by only 10 months of age infants

seemed to infer that their task was to simply follow the pointing behavior of the adult by assuming that the pointing refers to an entity. However, even though infants seem to learn following the pointing at 10 months of age, this does not mean that they do not make mistakes especially when the entity pointing refers to is outside of their immediate visual field.

Butterworth and Jarret (1991) also found that not until the infants are 18 months old they flexibly attend to targets behind them. Deak et al. (2000) further showed even 12 months old infants might have problems locating the targets behind them upon following the gaze of an agent.

Why the infants have problems when the experimenter points to or gazes at items outside of the visual field of infants is explained by the ecological mechanism hypothesis of Butterworth and Jarrett (1991). They claim that the experimenter's head turn accompanying the ostensive cue of pointing (or gaze for that matter) acts as an additional prompt helping the infant to shift his attention to the location of the item. Yet when there is a small change in the head turn of the experimenter, as it is the case when the experimenter points for an item behind the infant, this additional prompting property of head turn disappears making it difficult for infants to discern the referent of pointing.

Another possible reason for high incorrect look percentages of infants for behind items in our data might be to do with infants' difficulty in disengaging their attention. D'Entremont (2000) as he discussed why infants showed poorer performance when the target item was outside of their visual field, pointed out that younger infants might be prone to distractions. In other words, having peripheral items on the visual scanning trajectory of infants might had disengaged infants from further following the target item of the pointing act of the experimenter. For example if we did not use the peripheral items in our version of the PF task, but only behind items -since then there would be no item in the visual scanning trajectory of infants- the infants might be more inclined to turn their heads all the way to see the items

behind them, without distractions along the way. With peripheral items on their visual scanning trajectory, infants might fixate on the first item they encounter without the need to correctly follow the pointing act to its not-readily-visible referent. Deak, Flom and Pick (2000) argue that infants form only egocentric spatial representations about the entities around them by 18 months of age, meaning that infants could exploit what others are gazing at or pointing to only if they can themselves see it, but not if they cannot see it readily in their visual field. This hypothesis is also in line with Moore (2008) who argues that younger infants might be simply motivated to find any object upon seeing the pointing act of an agent whereas older infants might be more motivated to figure out what the agent is exactly pointing to. Apparently infants at the age of 12 months do not flexibly attend to things outside of their visual field.

However, the findings that the infants engaged in less no-look behavior by time, decreasing from 78.2% to 49.76% at 10 months and to 36.11% at 12 months (and there was no effect of the placement of the items in the no-look behaviors in any of the time points) and that the infants engaged in more frequently correct look behavior by time, increasing from 10.6% to 28% at 10 months and to 41% at 12 months, support that infants between 10 and 12 months of age know that the pointing act of another refers to an entity (Woodward & Guajardo, 2002), and they exploit this connection between pointing and referent assuming that pointing is about a distal target. Yet this connection they construe seems to easily break down when the referent is away from their midline, outside of their visual fields.

In terms of SES differences in point following performances of infants, we could not find an effect of SES in correct look, incorrect look and no-look behaviors of infants at any of time points. However, we found a marginally significant sex interaction with time on correct look percentages of infants. Females had slightly higher percentage of correct look behaviors

at the age of 10 months than males, however, males caught up with females at the age of 12 months.

5.4. Point Following in relation with Point Production

We hypothesized that point production skills of infants would be predicted from their point following skills, as we assumed that infants would first follow others' pointing behaviors and then produce pointings themselves. This hypothesis was partly confirmed. We found that the infants who spontaneously pointed at 10 months with their index fingers during the point following task were the ones with greater correct look percentages at 8 months in comparison the ones who did not show any spontaneous index finger pointing at 10 months. However, there were no such differences between pointers and non pointers, but only index finger pointers and non-index pointers showing the unique contribution of index finger pointing alone. This finding reveals that successfully following the pointing act of an agent to its referent might help infants to produce points by themselves.

However, we also found that not only index finger pointing infants but also whole hand pointing infants spontaneously pointing in the PF task at 10 months, had a greater correct look percentage at 12 months. Our decorated room data also showed that index-finger pointers at 10 months displayed more correct look behaviors at 12 months but this time only in contrast to non-pointers, and not to whole hand pointers. These two findings show us two things: First, index finger pointing might not be as unique as previously entertained in the previous literature (Liszkowski & Tomasello, 2011) considering not only index finger pointers, but also whole hand pointers correctly followed the pointing. Second, exercising pointing might lead infants to show greater performance in following the pointing behaviors of others. The latter conclusion is not compatible with the recent training study by Matthews et al. (2012) who showed predictive capacity of point following on pointing production.

Apparently the direction of the relationship between point following and point production is not one one-sided. It seems that production and following feed into each other, pointing production might help infants to follow pointing acts of others, and point following might help infants to exercise pointing production more frequently. Carpenter et al. (1998) in their seminal monograph reported that communicative gesture production emerged before the comprehension of communicative gestures for 21 infants in their study. Hence the intuitive hypothesis that the earlier point following skills of infants predict onset and frequency of point production is not fully supported.

We also found that non-pointing infants in decorated room at 12 months showed more incorrect look behavior at 12 months in comparison with index finger pointing infants at 12 months, but not with whole hand pointing infants at 12 months. This finding could be discussed within the framework of unique contribution of index finger pointing in socio-cognitive skills of infants (Liszkowski & Tomasello, 2011). We argue that by 8 months of age, index finger pointing might confer an early advantage to infants. Conversely, if infants are not pointing by any means at all by the time they are 10 months old, they might be in a great disadvantage in the socio-cognitive domain compared to both index finger and whole hand pointers.

One could criticize our finding that pointing infants at 10 months had greater correct look behaviors at 12 months indicating that we did not control for the correct look behavior of infants at 8 months or at 10 months to see whether producing pointing at 10 months predicts correct look percentages at 12 months over and above the infants' correct look percentages in previous time points. Extremely skewed pointing frequency data did not able us to confidently carry out hierarchical multiple regression. Besides we could not find a predictive effect of correct look performance at 8 months on the correct look performance at 12 months or a predictive effect of correct look performance at 10 months on the correct look performance at

12 months. This might be seen as partly justifying for not controlling for correct look percentages in previous time points.

When we looked at the relations between the frequency of pointing behaviors of infants and their correct look percentages in PF task, we further found that the percentage with which infants showed correct look behavior at 8 months was correlated with infants' number of whole hand pointings at 12 months (however, we should be cautious with this finding because even though we used spearman rank order correlations to assess the relation, the fact that 21 out of 30 infants' percentages of correct looks at 8 months were 0 might have biased the relation). And infants' number of whole hand pointings at 10 months was strongly correlated with the percentage with which infants showed correct look at 12 months, strengthening the claim that the relation between point production and following is bidirectional. Why these correlations were significant for whole hand pointing but not for index finger pointing is open to inquiry. One possibility is that whole hand pointing is driven by imitational mechanisms by which observing maternal pointing dominantly increases the likelihood for whole hand pointing. However, index finger pointing might be endemic in the sense that it is not influenced by maternal gestural input and requires certain socio-cognitive skills to be exercised frequently (i.e. point following skills, Matthews et al., 2012).

When it comes to maternal pointing frequency, this time a significant positive correlation was revealed between maternal pointing frequency at 8 months and infants' correct look percentages at 10 months. We further found that maternal pointing frequency at 8 months was negatively correlated with infants' no-look percentages at 10 months. It seems that more frequently observing pointing behavior produced by others helps infants to follow the referent the pointing acts refer to more successfully. Future studies should introduce training studies (for one recent training study on infant pointing please see Matthews et al.,

2012) not only in pointing production but also in point following skills of infants to assess whether observing pointing of others help infants to become better followers.

Our findings of the relations between pointing production and point following performance are in line with previous research (Carpenter et al., 1998; Mundy et al., 2007; Behne, Liszkowski, Carpenter, & Tomasello, 2011). However, we should also note that this relation is not found in some studies. For example Brooks and Meltzoff (2008) did not find a relation between gaze following and point production skills, further claiming that following gaze (or pointing) and spontaneously producing pointing might not necessarily be two different sides of the same coin but might rather tap different skills in the socio-cognitive domain. Different tasks used to elicit pointing behavior of infants and to measure their point followings skills might be one reason for inconsistencies in the literature

For example, we did not include only peripheral items in our point following study, but also the items that were positioned outside of the visual field of the infants which might have made our version of the PF task stricter in terms of correctly capturing point following skills of infants younger than the age of 12 months. Future research should investigate relations between production and comprehension of pointing gestures by systematically controlling for possible confounds which might be embedded in the measurements themselves.

5.5. Fine Motor Skills

Infants' fine motor scores as revealed by the fine motor scale of MSEL increased by time. There were no predictive effects of maternal index finger pointing frequency on fine motor scores of infants for any of the time points as we hypothesized. Further there were no sex differences, but a marginally significant SES and time interaction in infants' fine motor skills. There were no differences between low SES and high SES infants in their fine motor

skills at 8 months and at 10 months, but at 12 months high SES infants showed a trend in scoring higher in the fine motor subscale than low SES infants ($p = .07$).

SES differences in fine motor skills of preschool or school aged children, if not in infants, were found by previous studies (Piek, Dawson, Smith & Gasson, 2008; Gottschling-Lang, Franze, & Hoffmann, 2013). Gottschling-Land and his colleagues have discussed that high SES families were more likely to engage in physical activities with their children providing more enriched play environments (e.g. commercial physical-activity facilities) than low SES families. Although the influence of SES on early fine motor skill development was not an inquiry of previous research, it is likely that the way mothers shape the play environment for their infants is a key factor in fine motor development. SES differences, although only marginally significant, in fine motor skills of 12 months old infants in our data thus might be due to enriched play environments mothers with high education provide for their infants, letting them to exercise their fine motor skills.

In relation to pointing, we found that whole-hand pointing infants at 10 months scored better in fine motor development subscale at 8 months than non-pointing infants, but there were no differences between whole hand pointers and index finger pointers, or between index finger pointers and non pointers.

Fine motor development research has not much focused on the relation between early fine motor development and socio-cognitive skills in infants. Existing literature has focused on the young children with moderate or severe motor problems and on the gross motor development particularly. Limited research with the aim of bridging motor development with socio-cognitive development has strived to answer how acquiring motor developmental milestones earlier (i.e. being able to stand or walk) affects their later cognitive abilities at preschool age (e.g. working memory, executive function, academic achievement) (Bushnell & Boudreau, 1993; Burns, O'Callaghan, McDonell, & Rogers, 2004; Murray, Veijola,

Moilanen, Miettunen, Giahn & Cannon, 2006). One research assessing the effect of pincer grip performance on onset of pointing longitudinally with 8 to 14 months old infants could not find a relation between development of pincer grip skills and pointing behaviors of infants (Butterworth & Morisette, 1996). Hence our finding of the relation between fine motor skills of infants at 8 months and whole hand pointing frequency at 10 months is open to inquiry.

5.6. Vocabulary Development

12 month old infants were reported by their mothers to comprehend more phrases and to both comprehend and produce more vocabulary items than when they were 10 months old. When we separately looked at the action words and non-action words in the vocabulary section, more action words and non-action words were reported as comprehended and produced when the infants were 12 months old compared to when they were 10 months old. On the contrary to our hypothesis we could not find any effect of SES on the number of phrases comprehended by infants in any of the time points. However, we found a marginal effect of pointing behavior in decorated room at 12 months on phrases comprehended at 10 months. Infants who did not display any pointing behavior at 12 months were the ones who were previously reported as understanding fewer phrases, at 10 months, than index finger pointers but not than whole hand pointers.

In “starting to talk” items, where the mothers were asked two yes-no questions on whether their infants imitate the sounds or the prosody of speech mothers utter or whether they name any objects at all, there were no significant differences in infants’ scores between two time points. In line with our hypothesis though, we found that high SES infants had higher scores in this section at 12 months than their low SES agemates.

For vocabulary overall, even though we could not find any SES related difference we found again a main effect of pointing at 12 months on vocabulary comprehended at 10 months and at 12 months. Infants who displayed index finger pointing at 12 months were the

ones who were reported as comprehending more vocabulary at 10 months in contrast with non pointers, but not with whole hand pointers at the same age. Index finger pointers at 12 months were also reported to comprehend more vocabulary items at 12 months than non pointers, but not than whole hand pointers.

In terms of vocabulary produced by infants we could not find any SES or pointing effects for any of the time points. Yet given that the majority of infants at 12 months showed index finger pointing ($N = 26$), and only a small number of infants displayed whole hand pointing ($N = 5$), no-pointing ($N = 4$) we grouped 12 months old infants into index-finger pointers and non-index finger pointers (by treating whole hand pointers and non pointers the same). There was a marginally significant interaction between time and pointing level of infants at 12 months for vocabulary production. Index finger pointing infants produced more vocabulary by time; however, there were no difference in non-index finger pointing infants' vocabulary production between two time points. This finding might show that index finger pointers might confer an advantage in the rate of vocabulary production in comparison with infants who do not yet display index finger pointing at the age of 12 months, yet the results should be dealt with care since we had only nine infants as non-index finger pointers whereas we had 26 index finger pointers at 12 months.

We separated the vocabulary data into two by separately assessing action words and non-actions words infants comprehended and produced. We expected that infants' pointings would promote word learning opportunities particularly for non-action words as mothers tend to label things their infants point at. Action-words on the other hand might be more linked with the use of iconic gestures, rather than with declarative points per se. We should note that even though we also collected infant-mother interactions in a free play context lasted for five minutes, we did not include the analyses of the free play interactions in this study. It is probable that action word comprehension and production are related to the frequency of

iconic gestures mothers displayed for infants in addition to the linguistic input (e.g. verbs) accompanying the iconic gestures used.

For action word comprehension, on the contrary to our hypothesis we found that low SES infants had a larger vocabulary at 10 months and at 12 months in contrast with their high SES agemates. This difference was not observed in terms of action word production. Although the previous research has not looked for SES differences in early language with infants this young, we observed in the home visits we carried out for the general study entailing this work, that mothers with lower education tend to provide more action-labels for their infants and to give more directions and commands (e.g. do not touch, do not go there, come here etc.) as they interact with their infants. Even though it is not exactly clear why low SES infants were reported to comprehend more action words at two different time points than high SES infants, we could at least conclude that this difference was not due to pointing frequency of infants as there was no relation of pointing frequency or pointing type (i.e. index finger pointing) with SES in any of the time points.

The difference in the number of action-words comprehended by low SES and high SES infants did not translate to production of action words. Even though comprehension significantly predicted consequent production percentages of infants in the number of action-words, the number of words produced at the ages of 10 months and 12 months might be just too low to reveal any effect of SES.

For the relations between pointing and action word comprehension, we found a marginally significant interaction between time and pointing level of infants at 10 months in the action words they comprehended. Infants who did not show any pointing behavior at 10 months did not also show an increase in the action words they comprehended from 10 months to 12 months, yet index finger pointers and whole hand pointers at 10 months showed a significant increase in the number of action words they comprehended in time.

For the relations between pointing and non-action word comprehension, we again found a main effect of pointing at 12 months on non action word comprehension at 10 months. Infants who displayed index finger pointing at 12 months were reported to comprehend more non-action words at the previous time, than non-pointers at 12 months, but not more than whole hand pointers at the same age. Index finger pointers at 12 months were also found to comprehend more non action words at 12 months than 12 months old non pointers but again not than whole hand pointers at the same age.

The direction of the relationship between pointing and vocabulary seems to be bidirectional. Although it is a greatly entertained conclusion that infants' pointing promotes word learning opportunities (Bruner, 1983) by eliciting labels from mothers, it is not always the case that the ones who point more frequently at one time point are going to be the ones comprehending more vocabulary at the subsequent time point. It is also possible that the infants with larger receptive vocabulary size might be more reactive to those word learning opportunities, and mothers in turn might be pointing even more frequently for those infants, helping infants exercise their point following skills and their point production. All these findings summarized above show that we should construe pointing as a dynamic system, not only as a mean for early language development but also as an outcome of early language development.

For non-action word production we found a significant interaction between pointing and time. 12 months old index finger pointers' mean non-action words production increased from 10 months to 12 months significantly whereas there were no differences between two time points for non-index finger pointers. In addition, even though there were no differences in production between 12 months old index finger, whole hand and non pointers at 10 months, index finger pointers at 12 months produced more non action words than whole hand pointers, but not than non-pointers at 12 months.

12 months old infants used more gestures and actions than when they were 10 months old. We also found an interaction between pointing at 8 months and time. All infants used more gestures and actions by the time they are 12 months old, but 8 months old whole hand pointers scored greater than index finger pointers and non pointers at the same age at 10 months. We also found an effect of pointing at 12 months on actions and gestures infants used at 10 months and at 12 months. Infants who were pointing with their index fingers at 12 months were reported to use more actions and gestures in the previous time point in comparison with non-pointers, but not than whole hand pointers. Yet for gestures and actions used at 12 months, index finger pointers at 12 months were reported to use more actions and gestures than both non-pointers and whole hand pointers. This does not necessarily mean that index finger pointers at 12 months were at an advantage in terms of the development rate of actions and gestures they utilize, since there were 26 infants pointing with their index fingers at 12 months but only nine who yet did not display index finger pointing at the same time.

In relation to first communicative gestures infants used, surprisingly we could not find any effect of the type of pointing behavior on infants' percentage scores. Yet in line with our hypothesis we found that high SES infants tended to utilize more gestures ($p < 0.09$) than their low SES agemates at 12 months.

5.7. Predictory Power of Pointing on Early Vocabulary Development

Major weakness of this work is that we did not carry out any hierarchical models by including the entire infant pointing production variables to predict vocabulary development of infants. This was due to the non-normal distribution of the infant pointing frequency data.

Although, no general model for vocabulary development was sketched out of our data, simple regression analyses were carried out showing that maternal index pointing frequency at 8 months predicted action and non-action words comprehended at 10 months. Apparently mothers who pointed more frequently with their index fingers promote their infants' word

learning by creating joint attention episodes in which they verbally stimulate their infants.

Finding the predictive effect of maternal gestural input at 8 months on receptive vocabulary size of infants at such a young age as 10 months suggests that we need to study the effect of gestural input on language development.

Given the predictive effect of maternal index finger pointing frequency at 8 months on the display of infant pointing behavior (but not on frequency) at 10 months, we also found that 10 months old index finger pointers and whole hand pointers were the ones who were reported to comprehend more action words by time, whereas non-pointing infants at 10 months did not show a significant increase in the action words they comprehended (Please see Figure 19). Although the mean percentage of action words were not significantly different from each other in any of the time points for three groups of infants, pointer infants showed an increase in the percentage of action words they comprehended in contrast with non pointers. Yet we should note that discussed interaction was only marginally significant at the alpha level of .07.

10 month old index finger pointers also were found to display more correct looks in the point following task at 12 months, than non-pointers, but not than whole hand pointers. Correct look percentages of infants at 12 months significantly predicted the number of phrases they comprehended, the percentages of action and non-action words comprehended and action words produced at 12 months. It seems that caregiver pointing at 8 months predicted whether infants display any pointing or not at 10 months. And pointing, independent of the hand shape, at 10 months predicted higher percentage of correct looks at 12 months. Correctly following the referent of the pointing at 12 months apparently led to larger receptive vocabulary size, and larger productive vocabulary size for actions.

The predictive effect of point following was also evident by our hierarchical multiple regression models where we assessed whether point following performances of infants predict

the percentage of action words comprehended at 12 months above and beyond maternal index finger pointing frequencies. As it was reported, maternal pointing frequencies significantly predicted action word comprehension at 12 months, but point following skills of infants at 10 and at 12 months predicted the percentage of action words comprehended by infants over and beyond maternal pointing frequency. However, why this model predicted action word comprehension but not non-action word comprehension is open to inquiry.

5.8. Limitations

Our detailed analyses between the variables of early socio-cognitive skills give a perspective for future studies in terms of which variables to include in predicting early language development.

Regarding the relation between point production and following, Brooks and Meltzoff also (2008) found that 10 month old and 11 month old infants' performance in following the gaze of others and their spontaneously pointing predicted their productive vocabulary which was tested by CDI when they were two years old. Tomasello (2003) also showed a relation between gaze following and language. The reason that we could not sketch such a firm relation between our pointing variables and language measures is related to the skewed nature of the pointing and language data at young ages. There were only seven infants who pointed at 8 months, with the range of 1-2 when we excluded the one infant with 21 index finger pointings. The percentage of correct looks in the PF task was approximate to 10% at 8 months.

Our vocabulary measure could also be criticized since it was based on maternal reports, and only covered two months of very early language development, which might be construed as restricted as it does not allow for a lot of variance. For example at 10 months the maximum number of vocabulary reported as produced was 48, and at 12 months it was 58, with standard deviations of 9.65 and 12.78, respectively. Whereas the range of produced

vocabulary size reported in Brooks and Meltzoff's study (2008) was 272 to 458. Productive vocabulary grows rapidly after 14 months of age. Future studies, to assess the relation between pointing and vocabulary, should utilize older age groups while investigating the effect of declarative pointing on language development.

Further unlike the other point following tasks that were found to predict language acquisition, our PF task included peripheral and behind items which required infants to also follow the items outside of their visual fields. Furthermore, the experimenter did not alternate her gaze back and forth between the item and the infant as she pointed to the item for the sake of not confounding the task with "gaze following". Although the experimenter made sure that she caught the infants' gaze before she displayed the pointing act, having no gaze-alternation during pointing might have made our version of task a stricter measure of point following skills.

5.9. Final Remarks

Our findings suggest that the relation between point production and point following is not one sided and differences between index finger pointers and whole hand pointers are not particularly associated with distinctive performances in socio-cognitive domain at 10 months and at 12 months. In terms of following the pointing acts of others or for early language variables, index finger pointers do not seem to be at an advantage in comparison to whole hand pointers, at least not all the time. However, not being able to point surely puts infants at a disadvantage.

Our findings further suggest that we should rather construe pointing production as a dynamic system, in which various variables (not only maternal pointing frequency but also point following skills of infants) interact together in development of pointing production of infants. In terms of language development, again one should be careful while evaluating pointing frequency as an index of language development, rather language development also

seems to drive pointing frequency. For example we found that non-pointer infants at 12 months were reported as understanding fewer numbers of phrases at 10 months, in contrast with index finger pointers at 12 months. And index finger pointers at 12 months were the ones who were reported as comprehending more vocabulary than non pointers, but not than whole hand pointers at 10 months. Apparently the size of receptive vocabulary drives pointing production too. It might be because mothers who provide richer linguistic input accelerates their infants' vocabulary, and infants become tend to be motivated to point more for those mothers who are already responsive to them linguistically.

The intricate relationship between pointing and language might be further evaluated in line with how mothers construe their infants. For example, according to Caudill and Schooler (1973, cited in Kagitcibasi, 2009), American mothers tend to view their infants as autonomous and they do not refrain from encouraging them to express their needs and desires whereas Japanese mothers view their infants as “extensions” of themselves. Although carried out with 4-5 year old children, another study with Turkish-Dutch and Dutch mothers could not find a difference in autonomy-oriented parenting behaviors of two different cultural groups. There was also no relation of autonomy oriented parenting with education levels of mothers (Bilici, Durgel, Yagmurlu & Van de Vijver, 2010). Future studies should assess how parental etnotheories are reflected in socio-cognitive skills of infants. If mothers are not responsive when the infants are initiating joint attention since it is culturally believed that preverbal infants do not understand what is going around, then it is likely that these infants are not going to produce pointing as frequent as infants whose mothers are responsive to such joint attention initiating behaviors of infants.

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Appendix A. The tasks

Table A1. *The counterbalanced list of all the tasks carried out for this research and for all the tasks conducted in the main research*

Time Points			Tasks					
at 8 Months	CoR*	CoA**	Point	Tease & Block	Point	Mullen	A-not-B	
			Comprehension		Following			
at 9 Months	Home Observation with Scanning Technique and Home Inventory							
at 10 Months	CoR*	CoA**	Point	Tease & Block	Point	Mullen	A-not-B	Tige
			Comprehension		Following			
at 12 months	CoR*	CoA**	Point		Point	Mullen	A-not-B	Tige
			Comprehension		Following			

Note. Some infants received A-not-B first instead of Point Comprehension, with the other tasks being in the same order.

*CoR: Context of Regard (Decorated Room)

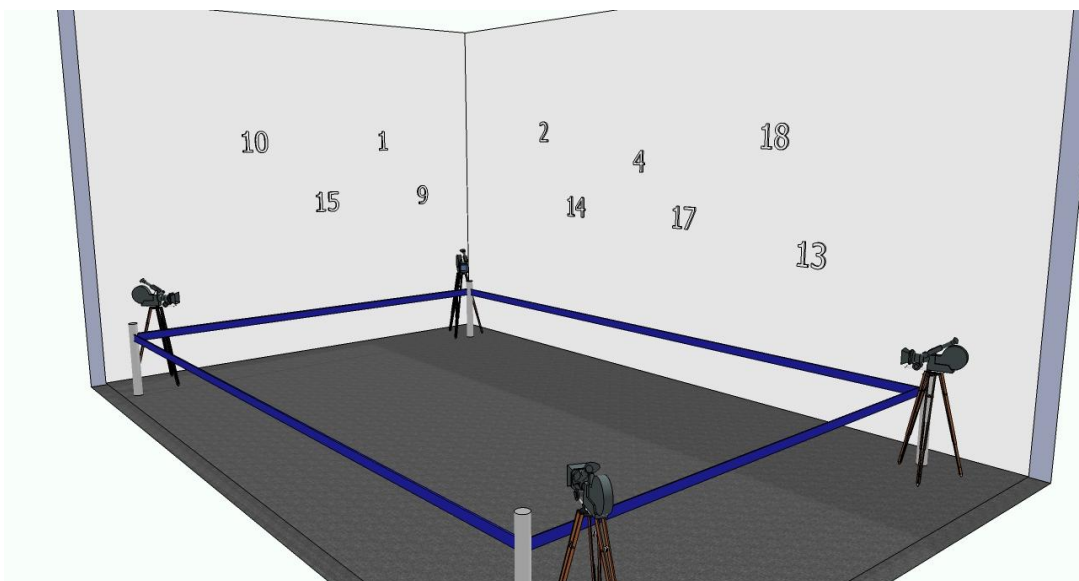
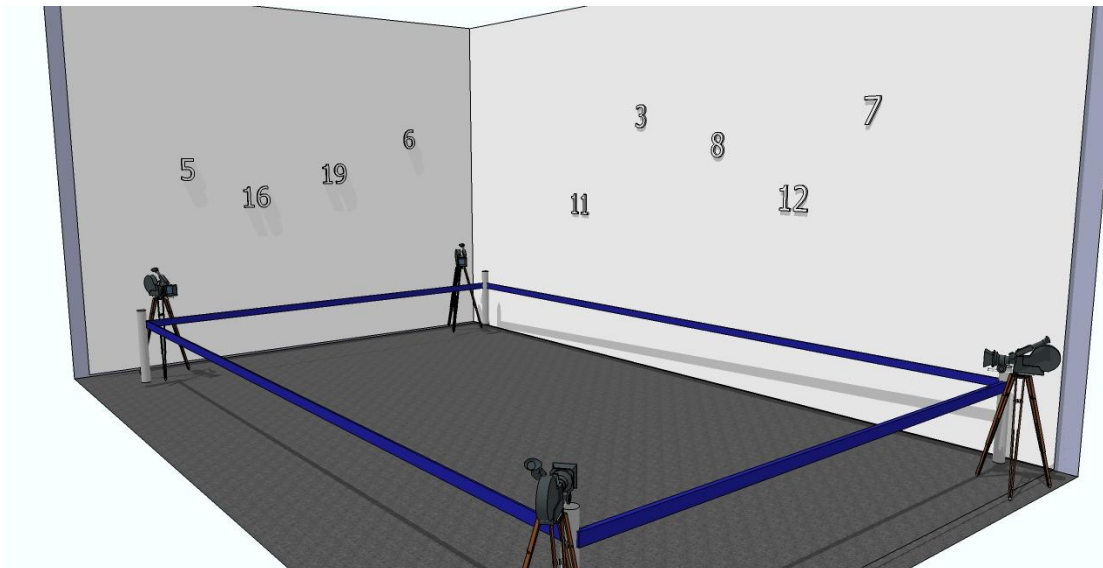
**CoA: Context of Activity (Free Play)

Appendix B. The summary of analyses for the infants who dropped-out after the first testing session

These analyses were only carried out for the infants who dropped-out after the first testing session ($N = 23$) and the remaining who continued testing sessions at the second or at the third time points ($N = 48$) to investigate whether there was a difference between these infants in some measures of the demographic variables. We could not find a significant difference between the ages of infants who dropped-out and the ones who did not ($t(69) = .61, p > .05$). There were no sex differences between the infants ($\chi^2 = .68, df = 1, N = 71, p > .05$) nor were there any SES related differences ($\chi^2 = .03, df = 1, N = 61, p > .05$). When we investigated whether there was a difference between the infants in their mothers' education levels we again could not find a statistically significant result ($\chi^2 = 5.74, df = 3, N = 71, p > .05$; please note that education level variable is categorical with four levels of having “at least eight years of education”, “at least 12 years of education”, “at least 14 years of education”, and at least 16 years of education”).

Appendix C. Schematic drawing of the decorated room displaying the items placed on its walls

Decorated room items: (1) one foldable clown face lantern, (2) a large butterfly, (3) a clown bell doll, (4) a dangling key ring, (5) a silver disco mirror ball, (6) a feather boa, (7) a Hawaiian flower lei, (8) a red bike light which flashes when it is set up, (9) pair of bike reflectors that are tied together, (10) a spiral pinwheel, a doll (11), (12) paper flowers, (13) a ball, (14) a balloon, and (15, 16, 17, 18) four posters of various animals, and (19) a Turkish coffee cup.



Appendix D. The positioning of the posters for the point following task at the experiment room



Appendix E. The original items on the fine motor subscale of Mullen Subscales of Early Learning (MSEL)

Ölçek 3. İnce Motor

Madde	Puan
► (1-4 ay)	
1. Kollar bükülü/eller yumruk biçiminde.....	1 0
2. İstemsiz olarak halkayı tutar.....	1 0
3. Yumruklarını ağızına götürür.....	1 0
► (5-8 ay)	
4. İki elin orta noktada birleşmesi.....	1 0
5. İstemsiz kavrama refleksi.....	1 0
6. Tahta çubuğu kavrar (avuç içinin dış yan kısmı)	1 0
► (9-12 ay)	
7. Küpe uzanır ve onu kavrar (daireselel avuç içi kavrama hareketi).....	1 0
8. Bir elinden diğerine geçirir, birbirine vurur, yere düşürür.....	1 0
9. İnce kavrama/başparmak kapalı.....	1 0
10. Pense biçiminde kavrar.....	2 1 0
1. kısmi pense hareketiyle	
2. belirgin pense hareketiyle	
► (13-17 ay)	
11. Küpleri tokuşturur, yatay hareket.....	1 0
12. Küpleri kaptan dışarı çıkarır ve kabın içine koyar.....	3 2 1 0
Aşama 1: 1 küp	1 içeri ya da 1 dışarı
Aşama 2: 4 küp	2 içeri ya da 2 dışarı
Aşama 3: 7 ila 8 küp	3 içeri
► (18-29 ay)	
13. İki elini birlikte kullanır.....	1 0
14. Kitabın sayfalarını çevirir.....	2 1 0
1) bir kaç sayfayı aynı anda	
2) birer birer	
15. Mum boyayla çizilmiş çizgileri taklit eder.....	3 2 1 0
Aşama 1: 1) herhangi bir yöne doğru	(aşamaların toplamı)
2) dikey çizgi	
Aşama 2: 3) yatay çizgi	
► (30-44 ay)	
16. Bozuk paraları yatay ve dikey olarak kumbaranın deliğinden içeri atar.....	2 1 0
Aşama 1: 1) 3 adet bozuk para/yatay	(aşamaların toplamı)
Aşama 2: 3) 3 adet bozuk para/dikey	
17. Küpleri üst üste koyar.....	3 2 1 0
1) 3-5 küp	
2) 6-8 küp	
3) 9 veya daha fazla küp	

18. 4 küpten yapılan treni taklit eder 2 1 0
 1) tren
 2) şoförü olan tren
19. Vida somununu cıvataya vidalar ve söker..... 1 0
20. Boncukları ipe dizer..... 1 0
 (3)
- (45+ ay)
21. 4 küpten yapılan kuleyi taklit eder..... 1 0
22. Daireyi, daire ve çizgiyi kopyalar..... 2 1 0
 Aşama 1: 1) daire (aşamaların toplamı)
 Aşama 2: 2) daire ve çizgi
23. Yol çizer..... 2 1 0
 Örnek Şekil 1 Şekil 2 Şekil 3
24. Makasla keser..... 2 1 0
 1) 1,5 x 6 cm'lik kağıt
 2) 3 x 9 cm'lik kağıt
25. Kağıdı üçe katlar..... 1 0
26. Çizimleri taklit eder..... 3 2 1 0
 Aşama 1: 1) daire içinde daire (aşamaların toplamı)
 Aşama 2: 1) kare
 Aşama 3: 1) sola yatık çapraz çizgi
27. Parmaklarını birbirine dokundurur I..... 1 0
28. Parmaklarını birbirine dokundurur II..... 1 0
29. Kare oluşturmak için kâğıdı ikiye katlar..... 1 0
30. Şekilleri ve harfleri kopyalar..... 5 4 3 2 1 0
 Aşama 1: 1) artı işareti (aşamaların toplamı)
 Aşama 2: 1) kare
 Aşama 3: 1) LED
 Aşama 4: 1) üçgen
 Aşama 5: 1) X

İnce Motor Ham Puan

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Appendix F. Turkish Communicative Development Inventory-I (TİGE-I)

“8-16 ay arasında bebekler duydukları dildeki sözcükleri anlamaya ve dönemin sonuna doğru da tek tek sözcükler üretmeye başlarlar. Sekiz aylık bu yaş diliminde gelişim hızlı seyreder ve bu dönemin başındaki ve sonundaki çocuklar arasında dil gelişimi açısından önemli farklılıklar görülür. Ayrıca her çocuğun gelişim hızı da farklıdır. Bu anket dil gelişimi açısından çok farklılık gösteren bu yaş dilimindeki çocuklar için düzenlenmiştir. O yüzden bahsedilen davranışlar ve sözcükler henüz sizin çocuğunuz tarafından kullanılmıyor olabilir. Dolayısıyla bunun bir sorun olduğunu düşünmenize gerek yoktur.”

“Bir sorunuz var mı?” (soru varsa cevaplandırınız)

“Peki, o zaman başlayabiliriz.”

BÖLÜM I: ERKEN SÖZCÜKLER

A. ANLAMAMANIN İLK İŞARETLERİ	
Çocuklar konuşmaya başlamadan önce bildikleri sözcüklere veya ifadelere cevap vererek dili anladıklarını gösterirler. Aşağıda bunlara ilişkin bazı örnekler verilmiştir. Sizin çocuğunuz bunlardan hangilerini yapıyor?	
	Evet Hayır
1. Adıyla çağırıldığında sese doğru dönerek ve bakarak tepki verir. O	O
2. “Hayır” dendiğinde kısa bir süre için yaptığını bırakarak tepki verir. O	O
3. “Anne/Baba burada” dendiğinde onları arayarak tepki gösterir. O	O

B. İFADELER (*tümce, sözcük öbeği*)

Aşağıdaki listede çocuğunuzun anladığını düşündüğünüz ifadeleri lütfen belirtin.

Anlar	Anlar	Anlar
Acıktın mı? O	Elleme/Dokunma. O	Aç ağzını. O
Uykun mu geldi? O	Kalk. O	Otur. O
Dikkatli ol. O	Bana ver. O	Tükür/Çıkar onu. O
Sessiz ol/Sus. O	Kucağıma gel. O	Dur. O
Ellerini çırp/Alkış. O	Öpücük ver. O	Yatma zamanı. O
Bezini değiştiririm. O	Git ... getir. O	Topu at. O
Buraya gel. O	Aferin. O	Buraya bir kuş konmuş. O
Evimize geldik. O	Kıpırdama. O	Gezmeye/Atta gidelim. O
Daha ister misin? O	Bay bay yap/El sallama. O	
Yapma. O	Bak/Buraya bak. O	

C. KONUŞMAYA BAŞLAMA			
	Hiç	Bazen	Çoğu
Zaman			
1. Bazı çocuklar “papağan” gibidir ve yeni duydukları şeyleri taklit ederler. Örneğin, siz “Anne/Baba şimdi işe gidiyor” dedikten sonra “işe gidiyor” diyerek cümlenin bir kısmını veya yeni öğrendikleri sözcükleri tekrar ederler.			
Sizin çocuğunuz sözcükleri ne sıklıkta taklit ediyor?	☐	☐	☐
2. Bazı çocuklar etrafta dolaşarak bildiklerini göstermek ister gibi çevrelerindeki nesneleri isimlendirirler.			
Sizin çocuğunuz bunu ne sıklıkta yapar?	☐	☐	☐

D. SÖZCÜK DAĞARCIĞI KONTROL LİSTESİ

Aşağıdaki liste küçük çocukların sözcük dağarcığında sıklıkla yer alan sözcükleri içermektedir. Biz, çocuğunuzun anladığı, ve de hem anlayıp hem söylediği sözcükleri merak ediyoruz. Çocuğunuzun anladığı ama henüz kullanmadığı sözcükleri anlar sütununda belirteceğiz. Çocuğunuzun anladığı ve kullandığı sözcükleri ise anlar ve söyler sütununda belirteceğiz. Çocuğunuzun bir sözcüğü burada yazıldığından farklı söylüyor olması bir şey değiştirmez (örneğin, *balık* yerine *bayık* veya *çay* yerine *tay* diyebilir), bu yine de onun sözcüğü bildiği anlamına gelir. Unutmayın ki aşağıdaki liste farklı yaş

gruplarındaki birçok çocuğun kullandığı sözcüklerden oluşmaktadır. Bu nedenle eğer çocuğunuz şu an yalnızca bir kaçını biliyorsa bu bir sorun değildir.

1. ÇEŞİTLİ SESLER VE HAYVAN SESLERİ (10)								
anlar ve söyler			anlar ve söyler			anlar ve söyler		
Cee	O	O	Havhav	O	O	Pisi-pisi	O	O
Cıss	O	O	Hop/Hoppa	O	O	Uf	O	O
Düt	O	O	Mee	O	O			
Ham	O	O	Möö	O	O			

2. HAYVANLAR (17)								
anlar ve söyler			anlar ve söyler			anlar ve söyler		
Arı	O	O	İnek	O	O	Kuzu	O	O

At	O	O	Kedi	O	O	Maymun	O	O
Ayı	O	O	Kelebek	O	O	Ördek	O	O
Balık	O	O	Köpek	O	O	Tavşan	O	O
Böcek	O	O	Kurbağa	O	O	Tavuk	O	O
Eşek	O	O	Kuş	O	O			

3. TAŞITLAR (7)

	anlar		anlar		anlar
	anlar	ve	anlar	ve	anlar
	söyler		söyler		söyler
Araba	O	O	Kamyon	O	O
Bisiklet	O	O	Otobüs	O	O
Gemi/Vapur	O	O	Tren	O	O

4. OYUNCAKLAR (8)								
anlar ve anlar söyler			anlar ve anlar söyler			anlar ve anlar söyler		
Balon	O	O	Kalem	O	O	Oyuncak	O	O
Bebek	O	O	Kitap	O	O	Top	O	O
Boya	O	O	Kova	O	O			

5. YİYECEK VE İÇECEKLER (43)								
anlar ve anlar söyler			anlar ve anlar söyler			anlar ve anlar söyler		
Armut	O	O	Havuç	O	O	Portakal	O	O
Ayran	O	O	Karpuz	O	O	Reçel	O	O
Bal	O	O	Kek	O	O	Simit	O	O
Balık	O	O	Kola	O	O	Su	O	O
Bisküvi	O	O	Köfte	O	O	Süt	O	O
Börek	O	O	Kurabiye	O	O	Şeftali	O	O
Çay	O	O	Limon	O	O	Şeker	O	O

Çikolata	O	O	Makarna	O	O	Tarhana	O	O
Çorba	O	O	Meyve	O	O	Tost	O	O
Domates	O	O	Muhallebi	O	O	Yemek	O	O
Dondurma	O	O	Muz	O	O	Yoğurt	O	O
Ekmek	O	O	Pasta	O	O	Yumurta	O	O
Elma	O	O	Peynir	O	O	Zeytin	O	O
Et	O	O	Patates	O	O			
Fıstık	O	O	Pilav	O	O			

6. GİYSİLER (18)								
anlar ve söyler			anlar ve söyler			anlar ve söyler		
Ayakkabı/Pabuç	O	O	Gömlek	O	O	Pantolon	O	O
Bez (çocuk bezi)	O	O	Gözlük	O	O	Pijama	O	O
Boncuk	O	O	Kazak	O	O	Şapka	O	O

Ceket	O	O	Kolye	O	O	Terlik	O	O
Çorap	O	O	Önlük	O	O	Tişört	O	O
Elbise	O	O	Palto	O	O	Yelek	O	O

7. VÜCUT BÖLÜMLERİ (17)								
anlar			anlar			anlar		
anlar ve söyler			anlar ve söyler			anlar ve söyler		
Ağız	O	O	Diş	O	O	Meme	O	O
Ayak	O	O	Diz	O	O	Parmak	O	O
Bacak	O	O	El	O	O	Popo	O	O
Baş/Kafa	O	O	Göbek	O	O	Saç	O	O
Burun	O	O	Göz	O	O	Yanak	O	O
Dil	O	O	Kulak	O	O			

8. KÜÇÜK EV EŞYALARI (27)								
anlar			anlar			anlar		
anlar ve söyler			anlar ve söyler			anlar ve söyler		
Anahtar	O	O	İp	O	O	Radyo	O	O
Ayna	O	O	Kağıt	O	O	Resim	O	O
Bardak	O	O	Kaşık	O	O	Saat	O	O
Battaniye	O	O	Kumanda	O	O	Sabun	O	O
Biberon	O	O	Kutu	O	O	Süpürge	O	O
Çanta	O	O	Kürek	O	O	Şişe	O	O
Çatal	O	O	Lamba/Işık	O	O	Tabak	O	O
Emzik	O	O	Pil	O	O	Tarak	O	O
İlaç	O	O	Pipet/Kamış	O	O	Telefon	O	O

9. MOBİLYALAR VE ODALAR (22)								
anlar			anlar			anlar		
anlar ve söyler			anlar ve söyler			anlar ve söyler		

Balkon	O	O	Kapı	O	O	Sandalye/İskemle	O	O
Banyo	O	O	Koltuk	O	O	Televizyon	O	O
Beşik	O	O	Lazımlık/Oturak	O	O	Tuvalet	O	O
Bilgisayar	O	O	Masa	O	O	Yatak	O	O
Buzdolabı	O	O	Merdiven	O	O	Yastık	O	O
Çekmece	O	O	Mutfak	O	O	Zil	O	O
Dolap	O	O	Oda	O	O			
Fırın	O	O	Pencere	O	O			

10. EVİN DIŞI (21)								
		anlar			anlar			anlar
		anlar ve söyler			anlar ve söyler			anlar ve söyler
Ay/Aydede	O	O	Güneş	O	O	Taş	O	O
Ağaç	O	O	Havuz	O	O	Toprak	O	O
Ateş	O	O	Kaydırak	O	O	Toz	O	O

Bahçe	O	O	Köprü	O	O	Yağmur	O	O
Çamur	O	O	Kum	O	O	Yaprak	O	O
Çiçek	O	O	Salıncak	O	O	Yıldız	O	O
Duvar	O	O	Sokak	O	O	Yol	O	O

11. GİDİLECEK YERLER (13)

anlar	anlar	anlar
ve	ve	ve
söyler	söyler	söyler
Atta	O	O
Bakkal	O	O
Çarşı	O	O
Dışarı	O	O
Deniz	O	O
Dükkan	O	O
Ev	O	O
İş	O	O
Köy	O	O
Market	O	O
Okul	O	O
Park	O	O
Pazar	O	O

12. İNSANLAR (21)								
anlar			anlar			anlar		
anlar ve			anlar ve			anlar ve		
söyler			söyler			söyler		
Abi	O	O	Baba	O	O	Kardeş	O	O
Abla	O	O	Çocuk	O	O	Kendi ismi	O	O
Adam	O	O	Bebek	O	O	Kız	O	O
Amca	O	O	Dayı	O	O	Nine	O	O
Anne	O	O	Dede	O	O	Palyaço	O	O
Anneanne/Ba								
baanne/	O	O	Doktor	O	O	Polis	O	O
Büyükanne								
Arkadaş	O	O	Hala	O	O	Teyze	O	O

13. OYUNLAR VE RUTİNLER (31)								
anlar ve söyler			anlar ve söyler			anlar ve söyler		
Aferin	O	O	Günaydın	O	O	Saklambaç	O	O
Alkış	O	O	Hoşçakal	O	O	Sürpriz	O	O
Alo	O	O	Hadi	O	O	Şarkı	O	O
Ayıp	O	O	Hayır	O	O	Takla	O	O
Banyo	O	O	İyi geceler	O	O	Tamam	O	O
Bay-bay	O	O	Kaka	O	O	Teşekkür/S ağol	O	O
Çiş	O	O	Kucak	O	O	Uyku	O	O
Dikkat	O	O	Mama	O	O	Var	O	O
Evet	O	O	Müzik	O	O	Yok	O	O
Gol	O	O	Ninni	O	O			
Güle-güle	O	O	Öcü	O	O			

14. EYLEM SÖZCÜKLERİ-I (63) Toplam 95								
anlar anlar ve söyler			anlar anlar ve söyler			anlar anlar ve söyler		
Acı (canı)	O	O	Çarp	O	O	Giy	O	O
Acık	O	O	Çek	O	O	Giydir	O	O
Aç	O	O	Çık	O	O	Gör	O	O
Açıl	O	O	Çıkar	O	O	Göster	O	O
Ağla	O	O	Çiz	O	O	Götür	O	O
Al	O	O	Dön	O	O	Gül	O	O
Anla	O	O	Döv	O	O	Isır	O	O
Ara	O	O	Dur	O	O	Islan	O	O
Atla	O	O	Dök	O	O	İç	O	O
At	O	O	Düş	O	O	İN	O	O
Bağır	O	O	Elle	O	O	İste	O	O
Bak	O	O	El salla	O	O	İt	O	O
Bas	O	O	Geç	O	O	Kaldır	O	O

Ört	O	O	Tara	O	O	Yıka	O	O
Sakla	O	O	Taşı	O	O	Yıkan	O	O
Salla	O	O	Tut	O	O	Yırt	O	O
Sallan	O	O	Uç	O	O	Yut	O	O
Sarıl	O	O	Uyan	O	O	Yürü	O	O
Say	O	O	Ver	O	O			

15. TANIMLAMAYA YARDIMCI SÖZCÜKLER (25)								
	anlar			anlar			anlar	
	anlar	ve		anlar	ve		anlar	ve
		söyler			söyler			söyler
Acı (lezzet)	O	O	Islak	O	O	Sıcak	O	O
Açık	O	O	İyi	O	O	Soğuk	O	O
Boş	O	O	Kapalı	O	O	Pis	O	O
Büyük	O	O	Karanlık	O	O	Tatlı	O	O
Çok	O	O	Kırmızı	O	O	Temiz	O	O

Benim	O	O	Şu	O	O	Sana	O	O
Bu	O	O	O	O	O	Biri	O	O

18. SORU SÖZCÜKLERİ (7)								
anlar			anlar			anlar		
anlar		ve	anlar		ve	anlar		ve
söyler			söyler			söyler		
Kim	O	O	Neden	O	O	Niye	O	O
Nasıl	O	O	Nereye	O	O			
Ne	O	O	Nerede	O	O			

19. YER BİLDİREN SÖZCÜKLER (10)								
anlar			anlar			anlar		
anlar		ve	anlar		ve	anlar		ve
söyler			söyler			söyler		
Altında	O	O	İçeride	O	O	Şurada	O	O
Arkasında	O	O	İçinde	O	O	Üstünde	O	O

Burada	O	O	Orada	O	O	
Dışarıda	O	O	Önünde	O	O	

20. BELİRLEYİCİ SÖZCÜKLER (8)						
		anlar			anlar	
	anlar	ve		anlar	ve	
		söyler			söyler	
Biraz	O	O	Hepsi	O	O	Öbürü
Çok	O	O	Hiç	O	O	Yine/Gene
Daha/Bir daha	O	O	İşte	O	O	

BÖLÜM II. EYLEMLER VE JESTLER

A. İLK İLETİŞİM JESTLERİ			
Bebekler ilk iletişim kurmaya başladıklarında, isteklerinin anlaşılması için işaret kullanırlar. Çocuğunuzun bu günlerde yaptığı işaretleri tanımlayan maddenin yanındaki seçenekleri işaretleyin. (ANKETÖR OKUYACAĞSA: “Çocuğunuzun bu günlerde yaptığı işaretleri okuyacağım listeden hangileri tanımlıyor belirtmenizi istiyorum”)			
Çocuğunuz:	Henüz	Bazen	Çoğu

	değil	zaman
1. Elindeki bir şeyi size göstermek için elini size uzatır.	O	O
2. Elinde tuttuğu bir nesneyi ya da oyuncacı uzatarak size verir.	O	O
3. İlgisini çeken bir olaya veya ulaşamadığı bir nesneye parmağını ya da kolunu uzatarak işaret eder.	O	O
4. Birisi ayrılırken (kendiliğinden) el sallayarak güle güle işareti yapar.	O	O
5. Kucağa alınmak istediğini belirten bir şekilde kollarını size doğru uzatır.	O	O
6. “Hayır” anlamında başını iki yana sallar ya da kafasını yukarı kaldırır.	O	O
7. “Evet” anlamında başını öne eğer.	O	O
8. “Şıışt/Suss..” anlamında parmaklarını dudağına değdirir.	O	O
9. Elini açıp kapayarak veya kolunu uzatarak bir şey ister.	O	O
10. Uzaktan öpücük yollar.	O	O
11. Yediği bir şeyin tadının iyi olduğunu belirtmek için dudaklarıyla “hımmm... yapar.	O	O
12. “Bitti/Gitti” anlamında uygun işaret kullanır (örn. boş avuçlarını gösterir, omuzlarını silker, vs..).	O	O

13. Kavanoz/Kutu kapağının açılması için ya da yapamadığı bir şey için (işaret ederek) yardım ister.	O	O	O
14. Tuvalet ihtiyacının giderilmesi için (işaret ederek/bezini çekiştirerek) yardım ister.	O	O	O
15. Sizin işaret ettiğiniz bir oyuncığa veya nesneye parmağınızı/kolunuzu izleyip bakar.	O	O	O
16. Kendine dikkat çekmek için annenin eteğini çeker/ses çıkarır.	O	O	O

B. OYUNLAR VE RUTİNLER		
Çocuğunuz aşağıdakileri yapabiliyor mu?		
	EVET	HAYIR
1. Cee/Cöö oyununa katılır.	O	O
2. Gıdı gıdı/Geldi geldi kara kedi/Badi kara geliyor oyununa katılır.	O	O
3. Tel sarar/Sar makarayı-çöz makarayı oyununa katılır.	O	O
4. Fış fış kayıkçı oyununa katılır.	O	O
5. Kovalamaca oynar.	O	O
6. Şarkı söyler.	O	O

7. Dans eder.	O	O
8. Annenin söylediği diğer oyunlara katılır.	O	O
Belirtiniz _____		

C. NESNELERLE EYLEM GERÇEKLEŞTİRME		
Çocuğunuz gerçek nesneler veya oyuncaklarla aşağıdaki davranışları gerçekleştirir mi veya yapmaya çalışır mı?		
	EVET	HAYIR
1. Kaşık veya çatalla yemek yer.	O	O
2. İçinde sıvı bulunan bir bardaktan içer.	O	O
3. Kendi saçını tarar veya fırçalar.	O	O
4. Dişlerini fırçalar.	O	O
5. Havluyla veya bir bezle elini, yüzünü siler.	O	O
6. Şapka giyer.	O	O
7. Çorap veya ayakkabı giyer.	O	O
8. Kolye, bilezik veya saat takar.	O	O
9. Kolunun üstüne başını koyup/gözünü kapatıp uyurmuş gibi yapar.	O	O

10. Yediği bir şey sıcaksa üfler/üf yapar.	O	O
11. Oyuncak uçağı tutup uçurur.	O	O
12. Telefonu kulağına tutar.	O	O
13. Çiçek koklar.	O	O
14. Araba veya kamyon iter.	O	O
15. Karşıya top atar.	O	O
16. Bir kaseden/şışeden bir diğerine su döker gibi yapar.	O	O
17. Bardağın içinde su varmış gibi kaşıkla karıştırır.	O	O

D. ANNE-BABA GİBİ DAVRANMA		
Aşağıda çocuklarınızın bebekleriyle veya oyuncak hayvanlarla yapabildiği eylemler var. Çocuğunuzun yaptığını gördüklerinizi işaretleyin/söyleyin.		
	EVET	HAYIR
1. Yatağı yatırır.	O	O
2. Üstünü örter.	O	O
3. Biberonla besler.	O	O
4. Kaşıkla yedirir.	O	O

5. Saçını tarar.	O	O
6. Sırtını sıvazlar veya gazını çıkartır.	O	O
7. Bebeği arabasıyla dolaştırır.	O	O
8. Bebeği sallar.	O	O
9. Öper veya kucaklar.	O	O
10. Başına şapka, ayağına çorap veya ayakkabı giydirir.	O	O
11. Yüzünü, ellerini siler.	O	O
12. Onunla konuşur.	O	O
13. Bezini bağlar.	O	O

E. YETİŞKİN DAVRANIŞLARINI TAKLİT ETME		
Çocuğunuz gerçek nesne veya oyuncaklarıyla aşağıdaki hareketleri yapıyor mu veya yapmaya çalışıyor mu?		
	EVET	HAYIR
1. Süpürgeyle/Elektrik süpürgesi ile süpürür.	O	O
2. Anahtarla kilitler.	O	O
3. Çekiçle çakar.	O	O
4. Testere ile keser.	O	O

5. Bilgisayar klavyesinde yazar.	O	O
6. “Okur” (kitabı veya sayfalarını açarak).	O	O
7. Çiçekleri sular.	O	O
8. Müzik enstrümanı (aleti) çalar (piyano, gitar veya flüt gibi).	O	O
9. Direksiyonu döndürerek araba kullanır/sürer.	O	O
10. Toz alır.	O	O
11. Kalem veya tebeşirle yazar.	O	O
12. Kürekle kazar.	O	O
13. Gözlük takar.	O	O
14. Ruj sürer/Makyaj yapar.	O	O

F. YERİNE KULLANMA

Oyun sırasında, çocuklar bazen bir nesnenin yerine bir diğerini kullanırlar.

Örneğin, muzı telefon gibi ya da kutuyu kamyon gibi kullanabilir. Sizin çocuğunuz da bu şekilde nesneleri birbirinin yerine kullanıyor mu?

EVET

HAYIR

O

O

Appendix G. Comparison of Infants' Pointing Behaviors at 8 months, 10 months and 12 months

G.1. 8 Months

We carried out Wilcoxon signed-ranks tests to assess whether index finger pointing behaviors of infants were different from their whole hand pointing behaviors at 8 months. There were 29 index finger points in total whereas there were 51 whole hand points. Median number of index fingers pointings for infants at 8 months was 0 (0-0) and median number of whole hand pointings for infants at the same time point was 0 (0-2) ($M_{IndexFinger} = .83$, $SD = 3.55$; $M_{WholeHand} = 1.46$, $SD = 2.59$). There were significant differences between whole hand pointing and index finger pointing behaviors of infants at 8 months ($Z = -2.29$, $p = .022$). Infants more frequently used their whole hands while pointing than their index fingers. We also carried out a spearman's rank order correlation to determine the relations between the number of index finger and whole hand pointings by only including the infants who were already pointing with their index fingers at 8 months ($N = 7$). There was a significant negative correlation between infants' index finger pointings and whole hand pointings at 8 months ($r_s(7) = -.78$, $p = .03$)

We further investigated what hand shape index finger pointers more frequently utilized. At 8 months index finger pointers ($N = 7$) produced index finger pointing 29 times whereas they produced whole hand pointing 11 times. However, this observed difference in the number of index finger pointings and whole hand pointing they produced was not significant as Wilcoxon signed-ranked test indicated ($Z = -.13$, $p > .05$). Median number of index fingers pointings for index finger pointers at 8 months was 1 (1-2) and median number of whole hand pointings for index finger pointers at the same time point was 1 (0-4) ($M_{IndexFingerPointing} = 4.14$, $SD = 7.44$; $M_{WholeHandPointing} = 1.57$, $SD = 1.71$)

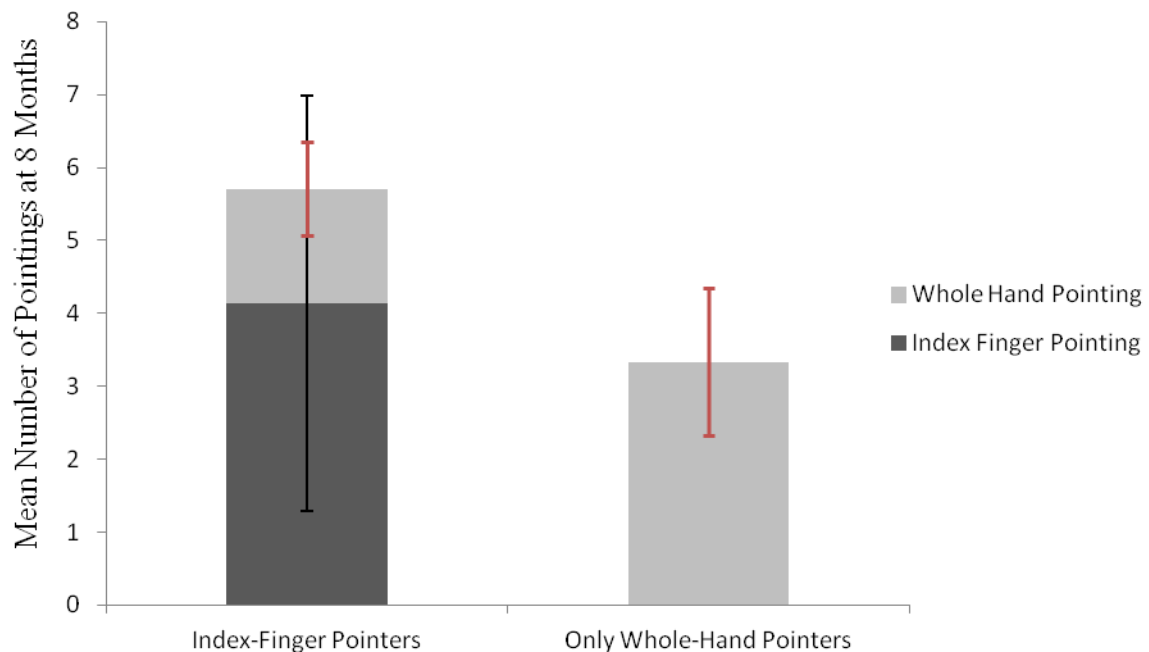


Figure G1. Mean number of index finger and whole hand pointings for the infants who pointed with their index fingers at least once and who pointed only with their whole hands at 8 months. Error bars show $\pm 1 SE$.

There were two infants who pointed only with their index fingers at 8 months whereas there were 12 infants who pointed only with their hands. Five infants used their hands while pointing to an item (or to a location) but their index fingers while pointing to another, thus there were 7 index finger pointers. There were 19 infants in total who displayed pointing behavior. The remaining, 16 infants, did not show any pointing behavior. In order to investigate whether the infants who pointed with their index fingers at least once ($N = 7$) pointed more frequently than the infants who pointed with their whole hands only ($N = 12$) we carried out a Mann-Whitney U test (Mann-Whitney $U = 25.5$, $p = .14$). There was no significant difference in the number of pointings between index finger pointers and whole hand pointers as Figure G1 also depicts. Also number of whole hand pointings did not differ between index finger pointers and only-whole-hand pointers (Mann-Whitney $U = 24$, $p = .14$).

G.2. 10 Months

We carried out Wilcoxon signed-ranks tests to assess whether index finger pointing behaviors of infants were different from their whole hand pointing behaviors at 10 months. There were 85 index finger points in total whereas there were 122 whole hand points. Median number of index fingers pointings for infants at 10 months was 0 (0-2) and median number of whole hand pointings for infants at the same time point was 1 (0-5) ($M_{IndexFinger} = 2.42$, $SD = 5.7$; $M_{WholeHand} = 3.48$, $SD = 5.41$). There were no significant differences between whole hand pointing and index finger pointing behaviors of infants at 10 months ($Z = -1.26$, $p = .214$). Infants did not more frequently point while they were pointing with their whole hands as they did when they were 8 month olds.

We further investigated what hand shape index finger pointers more frequently utilized. At 10 months index finger pointers ($N = 14$) produced index finger pointing 85 times whereas they produced whole hand pointing 47 times. However, this observed difference in the number of index finger pointings and whole hand pointings produced was not significant as Wilcoxon signed-ranked test indicated ($Z = -.91$, $p = .38$). Median number of index fingers pointings for index finger pointers at 10 months was 2.5 (1-8) and median number of whole hand pointings for index finger pointers at the same time point was 3 (0.75-5.25) ($M_{IndexFingerPointing} = 6.07$, $SD = 7.82$; $M_{WholeHandPointing} = 3.35$, $SD = 3.41$)

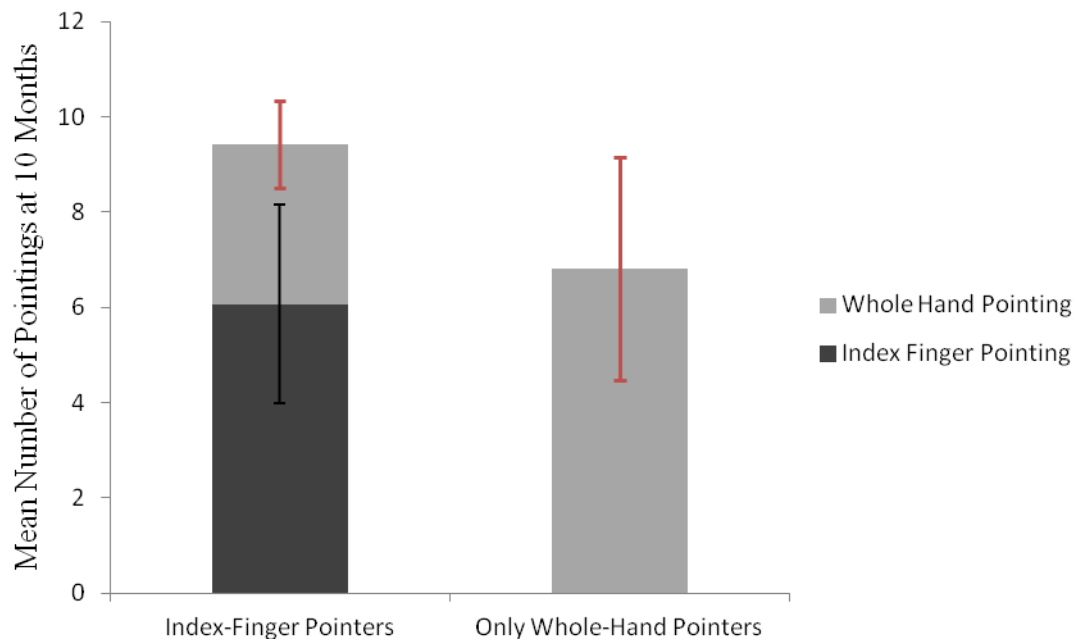


Figure G2. Mean number of index finger and whole hand pointings for the infants who pointed with their index fingers at least once and who pointed only with their whole hands at 10 months. Error bars show $\pm 1 SE$.

There were three infants who pointed with their index fingers only at 10 months whereas there were 11 infants who pointed with their hands only. 11 infants used their hands while pointing to an item (or to a location) but their index fingers while pointing to another, thus there were 14 index finger pointers. There were 25 infants in total who displayed some pointing behavior. The remaining, 10 infants, did not show any pointing behavior. In order to investigate whether the infants who pointed with their index fingers at least once ($N = 14$) pointed more frequently than the infants who pointed with their whole hands only ($N = 11$) we carried out a Mann-Whitney U test (Mann-Whitney $U = 53.5$, $p = .202$). We could not find a difference in the number of pointings between index finger pointers and whole hand pointers as Figure G2 also depicts. Also number of whole hand pointings did not differ between index finger pointers and only-whole-hand pointers (Mann-Whitney $U = 59.5$ $p = .34$).

G.3. 12 Months

We carried out Wilcoxon signed-ranks tests to assess whether index finger pointing behaviors of infants were different from their whole hand pointing behaviors at 12 months. There were 179 index finger points in total whereas there were 183 whole hand points. Median number of index fingers pointings for infants at 12 months was 3 (0-9) and median number of whole hand pointings for infants at the same time point was also 3 (1-7) ($M_{IndexFinger} = 5.11$, $SD = 5.79$; $M_{WholeHand} = 5.22$, $SD = 6.25$). There were no significant differences between whole hand pointing and index finger pointing behaviors of infants at 12 months ($Z = -.51$, $p = .618$). Infants did not more frequently point while they were pointing with their whole hands as they did when they were 8 month olds.

We further investigated what hand shape index finger pointers utilized more frequently. At 12 months index finger pointers ($N = 26$) produced index finger pointing 179 times whereas they produced whole hand pointing 155 times. However, this observed difference in the number of index finger pointings and whole hand pointings produced was not significant as Wilcoxon signed-ranked test indicated ($Z = -.19$, $p = .85$). Median number of index fingers pointings for index finger pointers at 12 months was 4 (2.75-10.25) and median number of whole hand pointings for index finger pointers at the same time point was 4.5 (1-7.25) ($M_{IndexFingerPointing} = 6.88$, $SD = 5.99$; $M_{WholeHandPointing} = 5.96$, $SD = 6.47$).

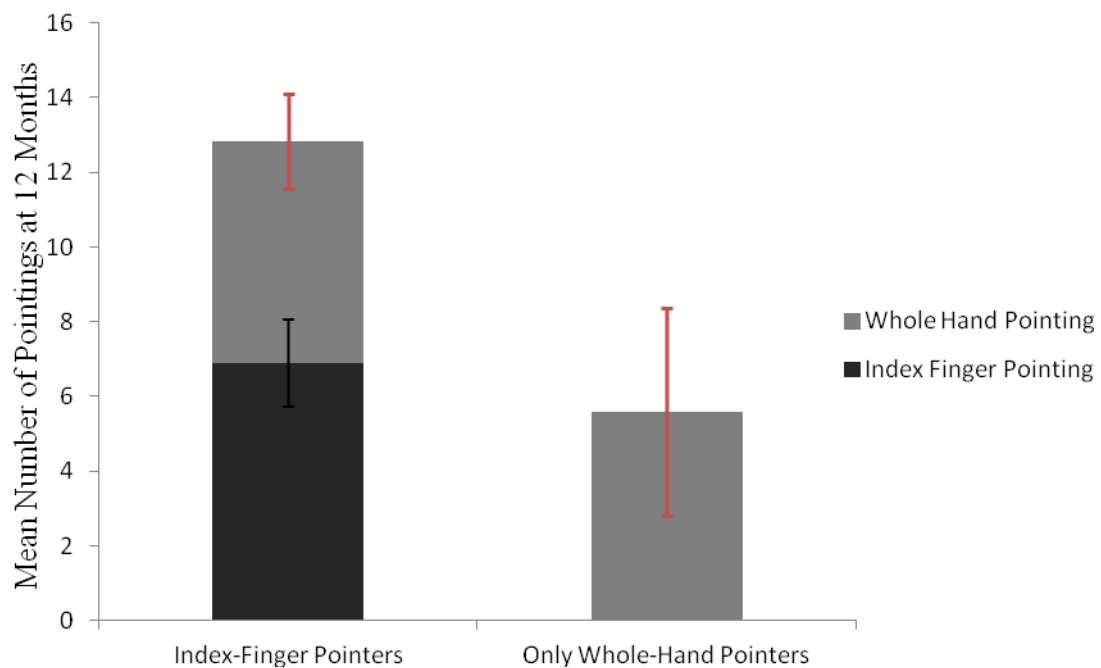


Figure G3. Mean number of index finger and whole hand pointings for the infants who pointed with their index fingers at least once and who pointed only with their whole hands at 12 months. Error bars show $\pm 1 SE$.

There were four infants who pointed with their index fingers only at 12 months whereas there were five infants who pointed with their hands only. 22 infants used their hands while pointing to an item (or to a location) but their index fingers while pointing to another, thus there were 26 index finger pointers. There were 31 infants in total who displayed pointing behavior. The remaining, four infants, did not show any pointing behavior. In order to investigate whether the infants who pointed with their index fingers at least once ($N = 26$) pointed more frequently than the infants who pointed with their whole hands only ($N = 5$) we carried out a Mann-Whitney U test (Mann-Whitney $U = 28$, $p = .04$). We found a statistically significant difference in the number of pointings between index finger pointers and whole hand pointers as Figure G3 also depicts. Index finger pointers more frequently pointed than whole hand pointers. Median number of pointings (independent of shape) for index finger

pointer infants at 12 months was 10 (2-16) and median number of pointings for whole hand pointer infants at the same time point was 2 (2-2) ($M_{IndexFinger} = 10.34$, $SD = 8.19$; $M_{WholeHand} = 1.84$, $SD = .37$). Both index finger pointers and whole hand pointers showed whole hand pointing in the same frequency (Mann-Whitney $U = 63.5$ $p = .93$).

G.4. Summary

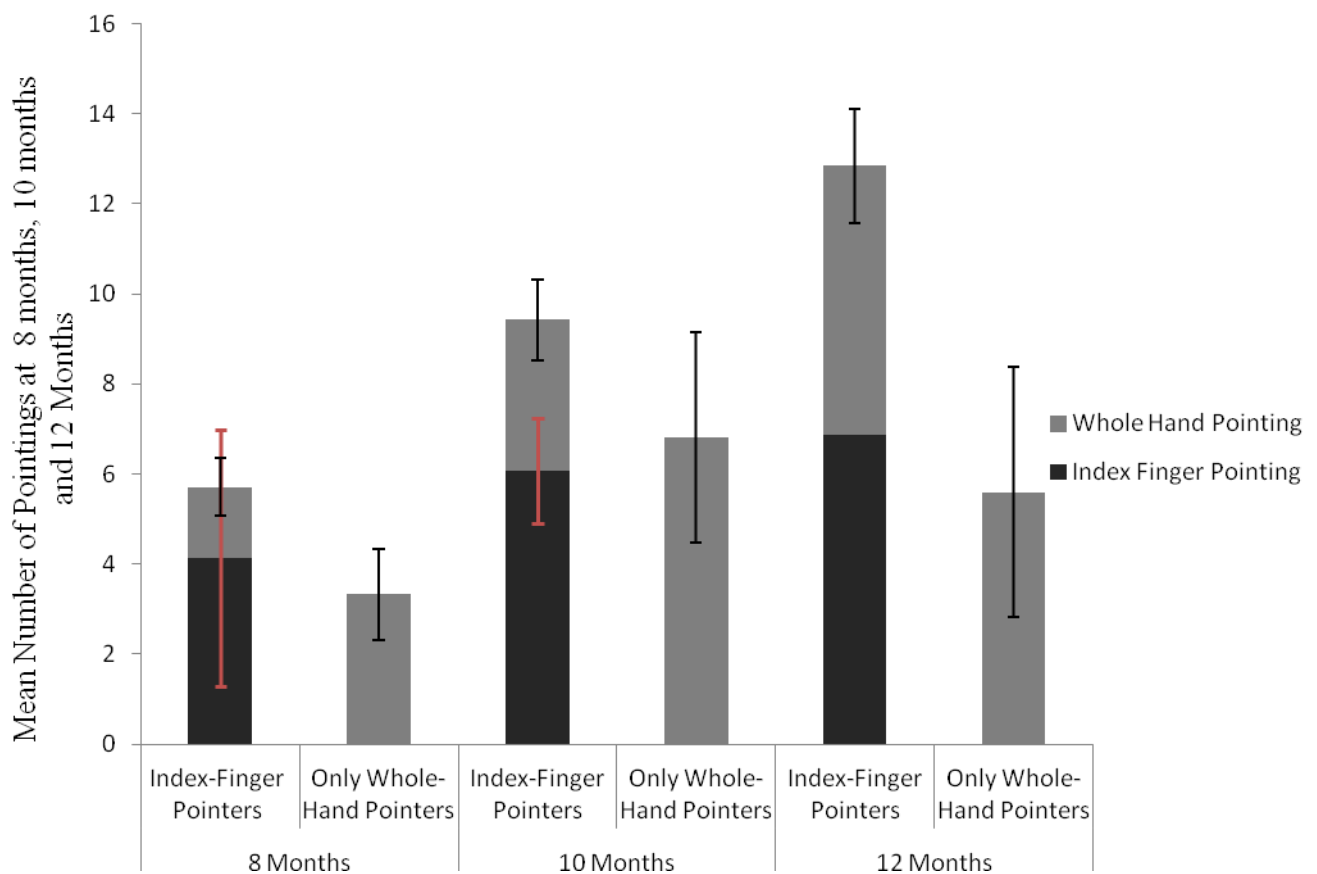


Figure G4. Mean number of index finger and whole hand pointings for the infants who pointed with their index fingers at least once and who pointed only with their whole hands at 8 months, 10 months and 12 months. Error bars show ± 1 SE.

As it can be seen from Figure G4 infants more frequently pointed while they were pointing with their whole hands at 8 months. Infants did not more frequently point while they were pointing with their whole hands at 10 months and at 12 months as they did when they were 8 month olds. At 12 months index finger pointers more frequently pointed than whole

hand pointers in general, but index finger pointers did not point more than whole hand pointers at earlier time points.

Appendix H. Infants with excluded trials in Point Following Tasks

Table H1. *Infants with excluded trials in Point Following Task at 8 months*

Infant Name	Nr of Trials Excluded	Reason for Exclusion
Ayşe Hilal Beygirci	1 (Left Behind Trial)	Fusiness
Sıla Kaplan	1 (Right Behind Trial)	Experimenter Error
Musa Yılmaz Egemen	1 (Left Behind Trial)	Mother Error
Semanur Cetin	1 (Right Behind Trial)	Fusiness

Table H2. *Infants with excluded trials in Point Following Task at 10 months*

Infant Name	Nr of Trials Excluded	Reason for Exclusion
Arya Sevik	2 (Right and Right Behind Trial)	Fusiness
Yusuf Asci	1 (Right Behind Trial)	Mother Error
Celal Efe Golduzu	2 (Left Behind and Right Behind Trials)	Fusiness

Table H3. *Infants with excluded trials in Point Following Task at 12 months*

Infant Name	Nr of Trials Excluded	Reason for Exclusion
Obahan Kayra	1 (Left Behind Trial)	Mother Error
Güngör Batuhan	1 (Right Behind Trial)	Fusiness
Yusuf Asci	1 (Left Trial)	Mother Error
Poyraz Arslan	1 (Left Behind Trial)	Mother Error

Table H4. *Infants with excluded trials at 8 months, 10 months and 12 months*

	Infant Name	Nr of Trials Excluded	Reason for Exclusion
	Ayşe Hilal Beygirci	1 (Left Behind Trial)	Fusiness
at 8 M	Yusuf Asci	1 (Left Behind Trial)	Mother Error
	Semanur Cetin	1 (Right Behind Trial)	Fusiness
at 10 M	Yusuf Asci	1 (Right Behind Trial)	Mother Error
	Arya Sevik	2 (Right and Right Behind Trial)	Fusiness
at 12 M	Yusuf Asci	1 (Left Trial)	Mother Error
	Poyraz Arslan	1 (Left Behind Trial)	Mother Error

Appendix I. Intercorrelations between time points in point following performances of infants

Table I1. *Summary of inter-correlations for percentage scores of point following tasks at 8 months, 10 months and 12 months*

Variable	1	2	3	4	5	6	7	8	9
1. Correct Look (8Ms)	-		-.75**						
2. Incorrect Look (8Ms)		-	-.77**						
3. No Look (8Ms)			-						
4. Correct Look (10Ms)				-	.38*				-.34*
5. Incorrect Look (10Ms)					-	-.8**	.28*		-.41**
6. No Look (10Ms)				-.85**		-	-.31*		.45**
7. Correct Look (12Ms)							-	-.29*	-.63**
8. Incorrect Look (12Ms)								-	
9. No Look (12Ms)								-.55**	-

Note. * $p < .05$, ** $p < .01$, $N = 36$