Maternal Behaviors and Joint Attention Mediate the Link between Maternal Education Levels and Infants' Language Development

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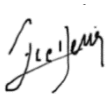

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ABSTRACT

One of the social contexts for children to learn their language is joint attentional (JA) interactions between adults and children. Specific maternal behaviors such as sensitiveness and intrusiveness have been found to be related to both maternal education levels and children' language development. Previous work has not explored how maternal behaviors are related to characteristics of JA episodes in mother-infant interaction and whether maternal education levels and maternal behaviors influence the language outcomes through JA episodes. The first aim of the study is to reveal which positive (e.g., sensitiveness) and negative (e.g., control) maternal behaviors are correlated with quantitative (e.g., frequency, duration) and qualitative (e.g., initiated by whom) features of JA episodes in mother-infant interactions. The second aim of the study is to investigate whether maternal education levels and maternal behaviors affect JA episodes in mother-infant dyads and in turn influence infants' language development. Fifty caregiver-infant dyads were video recorded during free play when the infants were 12 months old; expressive and receptive vocabulary of the infants were assessed at 14-months. The free play videos were coded for maternal behaviors (positive behaviors: sensitiveness, cognitive stimulation, positive affect; negative behaviors: negative affect, control) and JA characteristics (frequency, duration, initiated by maternal following or directing, being passive or coordinated, terminated by mother or infant). Results indicated that positive maternal behaviors were positively correlated with the mean duration of JA episodes and percentage of coordinated JA episodes while they were negatively correlated with the percentage of JA episodes terminated by mothers. Negative maternal behaviors were negatively related to mean duration of JA episodes and percentage of JA episodes initiated by maternal following. Further, we found an indirect relationship between maternal education levels and expressive language scores of infants which was mediated by maternal controlling levels and JA episodes initiated by maternal following or directing. Findings indicated that maternal behaviors play a crucial role in features of JA interaction in mother-infant dyads. Further, results support that maternal education level have an effect on language development of children via parenting and quality of mother-child interactions.

Keywords: joint attention, language development, maternal behaviors, maternal education

ÖZET

Çocukların dil öğrendiği sosyal bağlamlardan biri yetişkinler ile çocuklar arasında kurulan ortak dikkat etkileşimleridir. Duyarlılık ve müdahalecilik gibi anne davranışlarının hem anne eğitim seviyesi hem de çocukların dil gelişimi ile ilişkili olduğu birçok çalışma tarafından bulunmuştur. Önceki çalışmalar anne davranışları ile anne-bebek etkileşimi sırasında kurulan ortak dikkat süreçlerinin ilişkili olup olmadığını ve anne davranışlarının dil gelişimini ortak dikkat süreçleri üzerinden etkileyip etkilemediğini araştırmamıştır. Bu çalışmanın ilk amacı hangi pozitif (örneğin duyarlılık) ve negatif (örneğin müdahalecilik) anne davranışlarının anne-bebek etkileşimi sırasında kurulan ortak dikkat süreçlerinin niceliksel (örneğin sıklık, uzunluk) ve niteliksel (örneğin kim tarafından başlatıldığı) özellikleri ile ilişkili olduğunu ortaya çıkarmaktır. Çalışmanın ikinci amacı ise anne eğitim seviyesi ve anne davranışlarının ortak dikkat süreçlerini etkilediğini ve bunun sonucunda çocukların dil gelişimlerinin etkilendiği hipotezini incelemektir. Elli anne-bebek çifti bebekler 12 aylıkken beş dakikalık serbest oyuna katılmıştır; bebekler 14 aylıkken ise alıcı ve ifade edici dil bilgileri ölçülmüştür. Serbest oyun videoları hem anne davranışları (duyarlılık, bilişsel uyarım, olumlu/olumsuz duygulanım ve kontrol) hem de ortak dikkat süreçlerinin özellikleri (sıklık, uzunluk, ortak dikkatin annenin çocuğu yönlendirerek başlaması/annenin çocuğun dikkatini takip ederek başlaması, ortak dikkat sürecinde çocuğun annenin dikkatinin farkında olması/olmaması ve ortak dikkat etkileşiminin anne ya da bebek tarafından sonlandırılması) açısından kodlanmıştır. Sonuçlar pozitif anne davranışlarının ortak dikkat etkileşimlerinin ortalama uzunluğu ve ortak dikkat sürecinde bebeklerin annenin dikkatinin farkında olması ile olumlu yönde ve ortak dikkat süreçlerinin anne tarafından bitirilmesi ile olumsuz yönde ilişkili olduğunu göstermiştir. Negatif anne davranışlarının ise ortak dikkat süreçlerinin ortalama uzunluğu ve ortak dikkat süreçlerinin annenin bebeğin dikkatini takip ederek başlaması ile olumsuz yönde ilişkili olduğunu göstermiştir. Ayrıca sonuçlar anne eğitim seviyesinin bebeklerin dil gelişimini dolaylı bir şekilde etkilediğini ve bu ilişkide annelerin kontrol seviyesi ve ortak dikkat süreçlerinin annenin yönlendirmesiyle başlamasının aracılık rolü oynadığını göstermiştir. Bulgular anne davranışlarının anne-bebek etkileşimi sırasında kurulan ortak dikkat süreçlerinin özellikleri üzerinde önemli bir rol oynadığını göstermiştir. Ayrıca bulgular anne eğitim seviyesinin çocukların dil gelişimini ebeveynlik ve ortak dikkat süreçlerinin özellikleri üzerinden dolaylı bir şekilde etkilediğini ortaya koymuştur.

Anahtar kelimeler: ortak dikkat, dil gelişimi, anne davranışları, anne eğitim seviyesi

DEDICATION

To my parents and siblings,

for their endless support

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TABLE OF CONTENTS

1. INTRODUCTION

Language provides a basis for children to learn about the world and engage in social interactions. Early language competence is associated with other socio-cognitive skills like theory of mind and executive functions (Astington & Jenkins, 1999; White, Alexander, & Greenfield, 2017), and predicts later literacy and school readiness (Agostin, & Bain, 1997; Justice, Bowles, Pence Turnbull & Skibbe, 2009; Schoon, Parsons, Rush & Law, 2010). Individual differences abound in the size and rate of development of children's vocabulary (Fenson et al., 1994). One of the important contributors to these individual differences is the caregiver input. Both the quality (e.g., the number of words) and the quantity (e.g., different types of words) of caregiver speech affects children's vocabulary development (Hoff & Naigles, 2002; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Naigles & Hoff-Ginsberg, 1998; Rowe, 2012) and are associated with parental education. Caregivers with higher educational attainment address children with language that is richer in quantity and sentence complexity (Hoff, 2003; Vernon-Feagans et al., 2008). Besides the quantity and the quality, the timing of the caregivers' input also appears to be crucial. Children whose mothers respond contingently to their vocalizations achieve language milestones (e.g., first words, 50 words in expressive language) earlier than children with less sensitive mothers (Tamis-LeMonda, Bornstein, & Baumwell, 2001). Infants' vocabulary development also increases at a higher pace when caregivers talk about objects attended jointly by the infant and the caregiver (e.g., Tomasello & Farrar, 1986). Time spent in joint attention, where the infant and the conversational partner attend to the same object or event at the same time, is positively associated with children's language development (Carpenter, Nagell, Tomasello, Butterworth & Moore, 1998). Here, we propose that one way for parental education and maternal behaviors like sensitivity to affect infants' language development is through joint attention episodes in mother-infant dyads. Mothers with higher education levels tend to show more

positive behaviors towards their children (e.g., Richman, Miller, & LeVine, 1992) which may facilitate longer and high-quality joint attention episodes between mothers and their infants which in turn contribute to infants' language development. Thus, the primary goal of this longitudinal study was to investigate whether maternal education and maternal positive (e.g., sensitivity, positive affect) and negative (e.g., intrusiveness, negative affect) behaviors (at 12 months) affect infants' language development (at 14 months) via affecting the characteristics of joint attention episodes in mother-infant dyads (at 12 months). This study is the first to investigate the role of specific maternal behaviors in affecting the quantitative and qualitative features of JA episodes during mother-infant interactions. This study is also the first one examining the effect of both qualitative and quantitative characteristics on language development of infants at a very early age – 14-months. Parting from previous studies looking at the relationship between JA and language development, the current study examined the mediator role of maternal behaviors and features of JA episodes in the link between maternal education level and vocabulary knowledge of infants.

1.1. Development of Joint Attention and its Relation to Language Development and Maternal Behaviors

Joint attention (JA) is shared attention between a person and a social partner on an object, event, or symbol (Bakeman & Adamson, 1984; Markus, Mundy, Morales, Delgado & Yale, 2000; Seibert, Hogan, & Mundy, 1982; Tomasello & Farrar, 1986). Sharing experiences with a partner while having a mutual focus of attention has been proposed to optimize the capacity of infants to gain knowledge from social interactive environments (Baldwin, 1995; Bruner, 1981; Mundy et al., 2007). Being able to coordinate and maintain attention with another person to a common point of interest has been found to be a precursor of various pivotal facets of social, cognitive, and communicative development such as theory of mind (Mundy, Sigman and Kasari, 1994), self-regulation (Van Hecke et al., 2012), intelligence

(Saxon, Colombo, Robinson & Frick, 2000), and language development (Charman et al., 2000; Markus et al., 2000; Tomasello & Farrar, 1986; Saxon, Colombo, Robinson, & Frick, 2000).

JA capacity of infants emerges early. At around 6 months of age, infants start to respond to the JA bids of adults by following their gaze, vocalization, and pointing (Butterworth & Cochran, 1980; Scaife & Bruner, 1975). As infants reach around 9 months, they can initiate JA episodes with their partners using cues such as gestures and vocalizations (Bakeman & Adamson, 1984; Moore & Dunham 1995; Butterworth & Cochran, 1980). Around their first birthdays, infants start distributing their attention between objects and their partners (Crais, Douglas, & Campbell, 2004; de Barbaro, Johnson, Forster, & Deák, 2016) and they use declarative pointing gestures by which they can call their partners' attention to something interesting (Butterworth & Morissette, 1996; Camaioni, Perucchini, Bellagamba, & Colonnesi, 2004; Carpenter et al., 1998). Moreover, the way infants spend time in JA changes across time. For example, infants spend more time in symbol-infused JA in which they produce and respond to their caregivers' speech and gestures toward the end of the second year compared to younger ages (Adamson, Bakeman, & Deckner, 2004). Even though responding to and initiating JA abilities of typically developing infants emerge around similar ages, JA episodes vary across infant-caregiver pairs (in terms of their frequency and total duration; e.g., Markus et al., 2000; Mundy et al., 2007; Saxon & Reilly, 1999).

These individual differences reflected in infants' ability to respond to and initiate JA with an adult are associated with infants' concurrent and later vocabulary knowledge. Loy, Masur and Olson (2018) found that 13-month-old infants who initiated JA with their caregivers during free play sessions in a laboratory environment more frequently engaged in JA episodes at home as well and had greater receptive and expressive vocabularies at 17 months. Similar relations between JA and language development were observed when infants

were tested on their skills to respond to and initiate JA with a researcher. In a longitudinal study, Mundy et al. (2007) showed that the frequency of infants to respond to JA bids of a researcher at 12 months and their ability to initiate JA predicted their vocabulary knowledge at 24 months even after controlling for general aspects of cognitive development measured by the Bayley Scales of Infant Development-II (Bayley, 1994).

Infants' vocabulary development is not only related to their own ability to respond to and initiate JA with a conversational partner, but also how parents regulate their children's attention. By following 1-year-old children for five months by weekly visits, Tomasello and Todd (1983) showed that children learned more object labels when their mothers initiated JA by following rather than directing their infants' attention. Rollins (2003) further investigated the differential role of maternal language input that was either provided by following or directing the attentional focus of children. Results revealed that only mothers' contingent comments that were provided by following their infants' focus of attention were positively related to infants' word comprehension scores at 12 months. This positive correlation held even after controlling for the children's ability to respond to JA bids of their partners.

The importance of establishing a joint focus with children to teach them words was also shown by experimental studies. Tomasello and Farrar (1986) showed that 17-month-old children learned the names of novel objects better when the researcher taught the name by following the attentional focus of the children rather than by directing the children's attention. Baldwin et al. (1996) compared the conditions where an adult researcher taught novel words to 18- to 20-month-old children either when the experimenter shared or did not share the perspective of the child participants. They found that children learned novel words better when the researcher taught the words while sharing the perspective with the children.

Overall, these studies show that both infants' ability to respond to their caregivers' bids and initiate JA, and their caregivers' behaviors in relation to following and directing their

infants' attention affect acquisition of words and language development of infants in general. These studies also revealed that some characteristics of JA episodes have significant effects on language development including total duration (Carpenter et al., 1998), frequency (Loy et al., 2018) and the manner of initiation (e.g., whether adult directed or followed the focus of the child; Tomasello & Farrar, 1986; Tomasello & Todd, 1983). There are three main explanations about why JA is related to children's language development. First, adults are more inclined to talk about the objects, their properties or the actions that are already in the attentional focus of the child (Tomasello & Todd, 1983). Second, since children are aware of the attentional focus of the adults during JA interactions, it is easier for them to match a word that the caregiver produced to its referent (Tomasello & Farrar, 1986; Tomasello & Todd, 1983). Lastly, within JA episodes –as opposed to outside- mother-child conversations last longer and both mothers and children produce more utterances (Tomasello & Farrar, 1986). Therefore, JA provides an optimal environment for adults to provide language input to facilitate children's word learning.

Although the relationship between JA and language development is well-established, factors that affect the characteristics (e.g., frequency, initiation) of JA episodes are understudied. How JA episodes start and end, and how long they last are mostly in the control of infants' communicative partners as some partners may be more sensitive to infants' bids to establish JA and turn towards infants' attentional focus, whereas others may be more controlling and direct infants' attentional focus to particular points of interest more frequently. There are only a few studies investigating the relationship between maternal behaviors and JA in mother-infant dyads. Londoño and Farkas (2018) showed that relatively more sensitive mothers engaged in more shared interaction rather than no interaction with their infants at 12- to 14-months. Raver and Leadbeater (1995) found that, among socioeconomically disadvantaged adolescent mothers, more sensitive ones spent more time in JA with their

infants aged between 12 and 20 months. Further, Gaffan, Martins, Healy and Murray's (2010) study revealed that mothers' level of teaching at 6 months of age, in which they guided and encouraged their infants by instructions and demonstrations, predicted the time the dyads spent in shared attention at 9 months of age. These studies provide evidence that maternal sensitivity and guiding behaviors may affect the duration of JA episodes in mother-infant dyads. We suggest that maternal behaviors may also affect other characteristics of JA episodes such that more positive maternal behaviors would elicit JA episodes in which both partners are aware of the simultaneous focus of the other party; that are more frequently initiated by maternal following rather than maternal directing and; terminated more frequently by the infant rather than the mother. We also suggest that not only maternal sensitivity and guiding behaviors but also maternal controlling behaviors and affect (i.e. positive and negative) would be associated with the quantity and quality of the JA episodes.

1.2. Maternal Behaviors and Language Development: Possible Mediating Role of Joint Attention

Many investigate and find the pivotal effect of caregivers' behaviors on language development of children. Even though the quantity of language input provided by the parents has been found to be a significant predictor of children's language development (e.g. Huttenlocher et al., 1991; Newman, Rowe, & Ratner, 2016), the quality of input such as matching the verbal responses to the attentional focus of the children and using diverse vocabulary predicts children's language development beyond the quantity of the input (Tamis-LeMonda, Cristofaro, Rodriguez, & Bornstein, 2006).

One of the most studied and well-known maternal behaviors that plays a role in children's language development is maternal sensitivity (e.g. Landry, Smith, Miller-Loncar, & Swank, 1997; Tamis-LeMonda, Kuchirko, & Song, 2014). Sensitivity is described as mothers' accurate perception and interpretation of their children's needs and interests by

providing appropriate and emotionally warm responses to those signals (e.g. Ainsworth, Bell, & Stayton, 1974; Spiker, Boyce, & Boyce, 2002; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004). Previous longitudinal studies found that sensitive, in other words, responsive behaviors in which caregivers initiate and match their children's responses by considering their current developmental state strongly support children's cognitive and language development (e.g., Bohlin, Hagekull, Germer, Andersson, & Lindberg, 1989; Bornstein & Tamis-LeMonda, 1989; Hirsh-Pasek & Burchinal, 2006; Landry, Smith, Miller-Loncar, & Swank, 1998; Leigh, Nievar, & Nathans, 2001). For example, Tamis-LeMonda et al. (2001) demonstrated that infants of more sensitive mothers reached the language milestones such as first words, vocabulary spurts, and combinatorial speech 4 to 6 months earlier than infants of less sensitive mothers. Apart from sensitivity, maternal cognitive stimulation, in other words, guiding the children by providing essential speech and acts, and structuring the play according to the developmental level of the child, is also an important predictor of language development. Study of Silven, Niemi, and Voeten (2002) showed that mothers who provide more cognitive stimulation during free play episodes when their children were 1 and 2 years old had children with more advanced language comprehension and expression at both ages.

Maternal positive or negative affect is another factor that influences the language development of children. It has been found that positive affect displayed by mothers for their 24-month-old children, in which mothers expressed love, respect, and admiration, was positively correlated with children's receptive language scores at 36 months (Tamis-LeMonda et al., 2004). Kuhl (2007) argued that positive maternal behaviors (such as sensitivity, cognitive stimulation, and showing positive affect) may provide emotional security, which in turn encourage children to explore their environment, motivate them to attend to their caregivers, and learn language. Negative maternal behaviors are found to be associated with children's language acquisition as well. For instance, mothers' display of negative emotions

while interacting with their children is negatively associated with children's vocabulary knowledge (e.g., Tamis-LeMonda et al., 2004). Although not consistently, mothers' controlling behaviors have also been found to be related to children's language development. Tomasello and Farrar (1986) showed that mothers who mostly interact with their children by controlling their attention, in other words, directing their attention to new objects, have children with smaller expressive vocabulary at 21 months. The authors proposed that directing the attentional focus of children may interrupt their current point of interest and may be detrimental for the ability to connect caregiver's words to specific objects or events. On the other hand, Baumwell, Tamis-LeMonda, and Bornstein (1997) found no relation between maternal controlling behaviors at 9 months and infants' language comprehension at 13 months.

In sum, previous findings suggest tight relationships between maternal behaviors and children's language development. Building upon these findings, we suggest that one way for maternal behaviors to affect infants' language development is through JA episodes established between the mother and the infant. We hypothesized that positive maternal behaviors (i.e. sensitivity, cognitive stimulation and positive affect) will elicit better JA episodes in quantity (i.e. longer duration) and quality (i.e. coordinated, initiated by maternal following, terminated by infant), and in turn, these characteristics will have a positive effect on language development of infants. On the contrary, we hypothesized that negative maternal behaviors (i.e. negative affect and control) will elicit shorter and passive episodes that are more frequently initiated by maternal direction and terminated by the mother, which will in turn have negative effects on language development of infants. Further, we expected these relations to hold true even after controlling for maternal language input provided within the JA episodes and within the free play episode.

1.3. Relation of Maternal Education to Maternal Behaviors, Joint Attention and Language Development

A family's socioeconomic status (SES), in other words their social positioning and access to economic and social resources is a predictor of many parental behaviors and, in turn, children's socioemotional and cognitive development (e.g., Ashiabi & O'Neal, 2015; Bradley & Corwyn, 2002; Brito & Noble, 2014; Hackman & Farah, 2009; Hart & Risley, 1995; Hoff-Ginsberg, 1998). Findings of recent studies address that SES is an important factor that needs to be considered when investigating cognitive, social, and neural development (Conger & Donnellan, 2007; Demir & Küntay, 2014; Johnson, Riis & Noble, 2016). Many studies point that cognitive developmental constructs that are subjected to SES levels of families the most are language and executive function development of children (Brito & Noble, 2014; Merz, Maskus, Melvin, He & Noble, 2019; Noble, McCandliss & Farah, 2007). Hoff (2003) found that 2-year-old children with higher maternal education levels display greater growth in size of productive vocabulary compared to their peers with lower maternal education. Similarly, Dollaghan (1999) showed that 3-year-old children with more educated mothers, compared to less educated ones, have greater mean length of utterance, and comprehend and produce a greater number of words.

Many studies converge to show that maternal SES, especially maternal education level, is related to maternal language input directed towards children and maternal behaviors. The number of years mothers spend in formal education positively predicts the amount of talk and lexical diversity in the language input addressed to infants (e.g., Rowe, Pan, & Ayoub, 2005). Further, maternal education is positively related to maternal behaviors like sensitivity (e.g., Richman et al., 1992) and negatively related to behaviors like controlling (Tamis-LeMonda, Briggs, McClowry, & Snow, 2009). Some models suggest that SES levels of families have an indirect effect on the socio-cognitive developmental outcomes of children

(e.g. Family Investment Model, Family Stress Model; Conger & Donnellan, 2007; Johnson et al., 2016; Perkins, Finegood, & Swain, 2013). These models indicate that SES levels of families influence parenting style, quality and quantity of language, which in turn, affect the development of neural mechanisms related to language acquisition and development. In line with these approaches, studies revealed that SES levels of the families predicted the language outcomes of children through parental speech quality and quantity (Hoff, 2003; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010).

Even though the relationship between maternal SES, maternal behaviors and language development was examined in detail, how mothers from different SES backgrounds manage JA episodes with their young children is not known. To our knowledge, there are a few studies investigating the effect of maternal SES on maternal attention behaviors during JA episodes. Saxon and Reilly (1997) found that mothers with higher-SES levels are less persistent after their children accepted their JA bid compared to lower-SES mothers. This means that mothers with higher-SES levels allow their children to manage the JA episodes. Further, the study of Landry et al. (1997) indicated that children with higher-SES mothers started JA initiation behaviors earlier than children with lower-SES mothers. Moreover, it has been found that while 12-month-old children from higher-SES families are more likely to initiate JA episodes, children from lower-SES families have more tendency to follow others' JA bids (Abels & Hutman, 2015).

To sum, SES is an integral factor in language development, maternal behaviors, and JA interaction. Based on current findings, maternal education level is the strongest component of the SES that influences parental measures (Bornstein, Hahn, Suwalsky & Haynes, 2003; Hoff, Laursen, Tardif, & Bornstein, 2002). For this study, we recruited participant families from diverse educational backgrounds. We expected that maternal education level will influence the language outcomes of children through maternal behaviors and characteristics of

JA episodes. We conducted serial mediation analyses with maternal education as the first independent variable, maternal behaviors (sensitivity, cognitive stimulation, positive/negative affect and controlling) as the first mediator, characteristics of JA episodes (duration, how initiated, terminated, being passive/coordinated) as the second mediator and language scores of infants as the dependent variable. We will proceed only with the variables having significant relationships with each other.

1.4. Present Study

The primary aim of this longitudinal study was to investigate whether maternal education and maternal positive (e.g., sensitivity, positive affect) and negative (e.g., intrusiveness, negative affect) behaviors (at 12 months) affect infants' language development (at 14 months) via affecting the characteristics of joint attention episodes in mother-infant dyads (at 12 months).

We measured the characteristics of JA and maternal behaviors at 12 months in free play and infants' receptive and expressive vocabulary at 14 months via maternal report:

(1) We expected maternal behaviors to be associated with the quantity and quality of JA episodes. We expected positive maternal behaviors (sensitivity, cognitive stimulation, and positive affect) to be related to longer and coordinated JA episodes, where the infant shows awareness of the mother's simultaneous focus. Further, we expected that mothers who exhibited more positive behaviors initiated the episodes by following the attentional focus of infants and let the infants terminate the episodes more frequently. On the other hand, we expected negative maternal behaviors (negative affect, controlling) to be associated with shorter and passive JA episodes where infants did not show any sign shared focus with their mothers. We also hypothesized that mothers with more negative behaviors

initiated the JA episodes by directing infant's attention to another object/event and terminated the episodes themselves.

(2) We expected maternal behaviors to be associated with infants' language development and this relationship to be in part mediated by JA.

(a) A positive association between positive maternal behaviors and infants' vocabulary was expected.

(b) Based on previous research, we expected infants' vocabulary to be positively associated with the total duration of JA episodes and the proportion of JA episodes initiated by maternal following. We also hypothesized infants' vocabulary to be positively associated with the average duration of JA episodes as JA episodes lasting longer on the average may provide children more opportunities to infer word meanings compared to frequent but shorter episodes. We expected a negative relation between vocabulary and the proportion of JA episodes terminated by the mother. If it is the caregiver who frequently terminates the JA episodes, this behavior may be detrimental for word learning as the caregiver may not provide sufficient information about the entities that are in the infant's current attentional focus. Finally, we expected a positive relation between language development and the proportion of coordinated JA episodes where the infant shows awareness of the mother's simultaneous focus. Being aware of the caregiver's attentional focus and engaging in reciprocal games may help infants to match the words to its referents compared to a passive engagement between the infant and the mother where the infant does not demonstrate awareness of the interactional partner.

(3) We expected maternal education to be positively associated with positive maternal behaviors and language development. We expected a mediating role for maternal behaviors and JA between maternal education and language development such that higher maternal

education would elicit more positive maternal behaviors and longer and higher-quality JA episodes which facilitate infants' language development. On the contrary, we expected lower maternal education to elicit more negative maternal behaviors associated with shorter and lesser-quality JA episodes which hinder language development.

2. METHOD

2.1. Participants

The data for this study come from a larger longitudinal study investigating communicative, social, and cognitive development of infants from 8 to 18 months at 8 time points. We used the data of the entire sample from free play sessions at 12 months (M = 12.16, SD = 9.22 days) and measures of infants' receptive and expressive vocabulary reported by caregivers at 14 months (M = 14.16, SD = 12.11 days). At 12 months, 50 Turkish-speaking infants (27 girls) and their mothers participated in the study. Three infants were excluded due to developmental delay, growing up in a bilingual home, or being born prematurely. At 14 months, 43 out of those 47 families participated in the study. The mean age of the mothers was 31.40 (SD = 5.64) at their first visit when their infants were 8 months of age. Seven mothers (15%) were graduated from primary school, 7 (15%) from secondary school, 12 (26%) from high school,18 (37%) from college, and 3 (7%) had masters or PhD degree. One father (2%) was illiterate, 1 (2%) father graduated from primary school, 3 (5%) from secondary school, 19 (42%) from high school, 18 (40%) from college and 3 (5%) had masters of PhD degree. Mothers' average number of years in education was 11.50 (SD = 3.89) and fathers' average number of years in education was 12.39 (SD = 3.30). Thirty-one (66%) of the infants did not have a sibling, while 10 (21.3%) had one sibling, and 6 (9.8%) had two siblings when the infants were 8 months old. Data were collected in the Language and Communication Development Laboratory at Koç University. Parents received small gifts such as diapers and children's books at each visit.

2.2. Materials and Procedure

At 8 months, demographic information (e.g., parents' education level, information about children) was collected from the mothers. At 12 months, mothers and infants participated in 5-minute free play sessions in the laboratory. Mothers were given a basket of age-appropriate toys and instructed to play with their infants as they do at home. The toys were a drum with two drumsticks, a car, a duck, a shape sorter with eleven colorful geometric shapes, and a colorful tower puzzle with seven beakers. Free play sessions were recorded with four cameras in each corner of the room. At 14 months, mothers reported on their infants' receptive and expressive vocabulary via the Turkish version of the MacArthur-Bates Communicative Development Inventory (Aksu-Koç et al., 2019; Fenson et al., 2007). Infants' raw vocabulary scores were used in the analyses.

2.3. Data Coding

Maternal behaviors. Maternal behaviors were coded from free play videos based on the Mother-Child Affect, Responsiveness and Engagement Scale (C-CARES, Tamis-LeMonda, 1999; Tamis-LeMonda et al., 2009; see Table 1 for a more detailed explanation of the scale). This scale consists of five subscales where each subscale has two or three further items. *Sensitivity* was coded based on the responsiveness and participation items; *Cognitive Stimulation* was coded based on the structuring and explanatory language items; *Positive Affect* was coded based on the positive affect and positive verbal expressions*; Negative Affect* was coded based on the negative affect and negative verbal expressions; *Control* was coded based on the intrusiveness, inflexibility, and directive language items.

Table 1.

Maternal Behaviors Coding Scheme

Items	Definitions and Examples
Sensitivity	
Responsiveness	Caregiver replies to child's verbal statements, questions, and nonverbal behaviors with contingent and appropriate responses. Examples include responding to the child's requests for help, handing over objects out of the child's reach as the child looks toward them, providing instructions that are keyed into the child's current focus and responsive to the child's initiations.
Participation	Caregiver is highly engaged with the child during the task, as expressed through behaviors such as sitting close to child, attending to the child's actions, and maintaining focus on the child and task during the entire session.
Cognitive Stimulation	
Explanatory Language	When speaking to the child, the caregiver displays a style of communication that contains high use of descriptive and explanatory language, as characterized by high use of labels, adjectives, adverbs, and questions to child (e.g., “Those are the ingredients for the cake”; “Where do you think the red piece goes?”; “Which utensil should we use?”).
Structuring	Caregiver structures the task for the child so as to facilitate the child's performance. This includes indicating where materials are that the child needed, placing objects within reach of the child, handing the next object to the child, or verbally indicating steps to the process of completing the task.
Positive Affect	
Positive Affect	Caregiver demonstrates positive affect and emotional tone towards the child through facial expression (smiles, laughter), gestures (hugging), and voice.
Positive Expressions	Caregiver makes encouraging statements of approval and affirmation towards the child, including praise and acknowledgement (e.g., “Good job!; I know it is difficult”), and other forms of positive reinforcement.
Negative Verbal	

Negative Affect	Caregiver demonstrates negative affect towards child through facial expressions (frowns, negative expression), gestures (pushing or pulling child), and voice tone (anger or harshness).
Negative Expressions	Caregiver expresses disapproval towards the child verbally, including criticizing child ("You are making a mess") and discouraging statements or discontent ("I don't like what you're doing").
Controlling	
Intrusiveness	Caregiver displays high levels of control and intrusiveness during the interaction, by prohibiting child's actions, interrupting child's actions, and taking over the task. Examples include the caregiver hovering over the child, restricting the child's behaviors, taking objects away from the child, introducing new objects or actions while the child is engaged in something else, refusing to hand over objects to the child that are needed so that the caregiver can complete the project without the child actively participating.
Inflexibility	Caregiver is unable to "bend the rules" during interactions and is inflexible by not accepting the child's initiatives. Examples include, insisting that the child engages in a particular activity selected by the mother, even if the child wishes to do something different, and not switching to a different strategy or task when the current strategy is not effective with the child.
Directive Language	When speaking to the child, the caregiver displays a style of communication that contains high use of imperatives (commands) and high use of pronouns rather than descriptive language (e.g., "Put that one there". "Get that one").

For the coding of maternal behaviors, free play videos were divided into five one-minute samples and each sample was coded for maternal behaviors on a 5-point Likert scale ranging from 1 = "not observed" to 5 = "constantly observed". For each behavior category, mothers received an average score calculated over five one-minute video samples. Maternal behaviors were coded by a trained coder, and a randomly selected 20% of the videos were coded by the first author. Intraclass correlation analyses between the two coders showed high reliability for each of the categories; Cronbach alphas ranged from .84 to .96.

Joint Attention. The definition and coding scheme of Joint Attention were adapted from the studies of Tomasello and Todd (1983), and Bakeman and Adamson (1984). An interaction was coded as joint attention if both the infant and the mother looked at the same object for at least 3 seconds. We coded for (1) the duration, and (2) the number of the JA episodes as well as (3) how JA episodes were initiated and (4) terminated, and (5) whether a JA episode was characterized as passive or coordinated. *Total duration* corresponds to the sum of the durations across all JA episodes. *Average duration* was calculated by dividing the total duration to the number of JA episodes.[1] We coded the initiation of the JA episodes as *Mother Directs* if the episode started with the mother's attempt to shift the attention of the infant to a toy or activity. The initiation was coded as *Mother Follows* if the mother joined into the infant's ongoing focus of attention. A JA episode was coded as *Terminated by Infant (mother)* if the infant (mother) looked away from the jointly attended object or activity first for at least 3 seconds. We lastly coded the type of JA between the partners as *Passive* if both partners look at the same object or activity where the infant showed little awareness of the mother's involvement. A JA episode was coded as *Coordinated* if the infant demonstrated explicit awareness of the mother's involvement through looks at the mother's face, vocalizations, gestures, or turn-taking activities (see Table 2 for a more detailed explanation of the scale). JA episodes were coded using the ELAN software (Lausberg & Sloetjes, 2009). The coding was done by the first author and another coder who did not code the maternal behaviors. Fifteen percent of the videos were randomly selected for calculating interrater reliability. Intraclass correlations were high among the two coders: Cronbach alphas ranged from .85 to .98.

[1] If the last joint attention episode was ended by the experimenter, that episode was not included in the calculation of joint attention average duration.

Table 2.

Joint Attention Coding Scheme

Items	Definitions
Frequency	Number of JA episodes
Total Duration	Sum of all JA episodes' duration
Average Duration	Total JA duration divided by the number of JA episodes
How JA Episodes Initiated	
Mother Follows	When the mother joined into the infant's ongoing focus of attention
Mother Directs	When the episodes started with the mother's attempt to shift the attention of the infant to a toy or activity
Type of JA Episodes	
Coordinated	When the infant demonstrated explicit awareness of the mother's involvement through looks at the mother's face, vocalizations, gestures, or turn-taking activities
Passive	When both partners look at the same object or activity where the infant showed little awareness of the mother's involvement
Who Terminated the JA Episodes	
Mother	If the mother looked away from the jointly attended object or activity first for at least 3 seconds
Infant	If the infant looked away from the jointly attended object or activity first for at least 3 seconds

Note. Abbreviations: JA = Joint Attention

***Infant-directed speech*.** Mothers' speech was transcribed based on the CHAT rules of the CHILDES system and the number of total words used by the mothers was calculated using the CLAN software (Child Language Analysis; MacWhinney, 1996). We also calculated the

number of words mothers produced only during the JA episodes. One coder transcribed the free play videos and another coder went over 20% of the videos for reliability check. Intraclass correlation based on the total number of words between the coders was .97.

3. RESULTS

Descriptive information on demographic information, maternal behaviors, JA, vocabulary scores, and infant-directed speech are presented in Table 3. Two-sample t-test analyses showed no significant differences between males and females for any of the variables (all *p*'s > .05). Table 4 shows the correlations between the study's variables. Due to the multiple correlations, we used Bonferroni correction to decide the critical *p* value which was indicated as .048.

Table 3.

Descriptive Statistics of the Maternal Behaviors, Characteristics of Joint Attention Episodes, Language Scores and Maternal Education Level

Variables	*M*	*SD*	Range
Sensitivity (1-5)	2.55	.52	[1.1-3.7]
Cognitive Stimulation (1-5)	2.22	.47	[1.1-3.3]
Positive Affect (1-5)	2.13	.57	[1.1-3.2]
Negative Affect (1-5)	1.65	.56	[1.0-3.2]
Controlling (1-5)	1.91	.60	[1.1-3.7]
Maternal Input Word Count	182.40	89.70	[9-378]
JA-Inside Word Count	26.55	22.68	[0.0-115]
JA Frequency	6.43	2.26	[2-11]
JA Total Time (sec)	191.16	62.75	[32.88-296.83]
JA Average Time (sec)	31.16	17.19	[10.96-80.67]
JA Initiated by Mother (%)	67.17	23.87	[.00-100]

JA by Mother Follows-in (%)	32.82	23.87	[.00-100]
JA Mother Terminates (%)	42.19	24.35	[.00-100]
JA Infant Terminates (%)	47.91	28.08	[.00-100]
JA-Passive (%)	35.05	22.30	[.00-80]
JA-Coordinated (%)	64.94	22.31	[20-100]
Receptive Vocabulary (word count)	198.40	95.56	[37-418]
Expressive Vocabulary (word count)	34.49	46.12	[0-211]
Maternal Education (years)	11.50	3.89	[5-17]

Note. One outlier data point was excluded from the average joint attention duration (148.42 sec.). Abbreviations: JA = Joint Attention.

Table 4.

Correlations Between Maternal Behaviors, Characteristics of Joint Attention Episodes, Vocabulary Scores and Maternal Education Levels

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.Sensitivity	1													
2.Cognitive Stimulation	.59**	1												
3.Positive Affect	.69**	.51**	1											
4.Negative Affect	-.51**	-.17	-.46**	1										
5.Controlling	-.25	-.06	-.25	.59**	1									
6.JA Frequency	-.04	.10	-.02	.16	.19	1								
7.JA Total Time	.63**	.55**	.52**	-.37*	-.07	.08	1							
8.JA Average Time	.44**	.29*	.32*	-.32*	-.15	-.58**	.63**	1						
9.JA Ini. by Mother Dir.	-.19	.08	.06	.11	.34*	.12	-.01	-.19	1					
10.JA Term. by Mother	-.42**	-.09	-.27	.10	.00	-.21	-.07	.16	.02	1				
11.JA-Passive	-.30*	-.02	-.19	.23	.03	.22	-.41**	-.43**	.30*	.08	1			
12.Receptive Vocabulary	.25	.03	.18	-.03	.00	-.08	.06	.06	-.23	.08	-.11	1		
13.Expressive Vocabulary	.32*	-.02	.27	-.14	-.18	-.08	.16	.31*	-.39**	.18	-.32*	.60**	1	
14.Maternal Education	.35*	.30*	.41**	-.37*	-.36*	.16	.24	.05	-.17	-.17	.06	-.00	.21	1

Note. * = $p < .05$, ** = $p <. 01$ (two-tailed). Pearson Correlation *r* values were reported. Since JA-Passive and JA-Coordinated, JA-Mother Directs and JA-Mother Follows, JA-Mother Terminated and JA-Infant Terminated scores are mutually exclusive, only one of them was reported. Abbreviations: JA = Joint Attention, Ini. = Initiated, Term. = Terminated.

3.1. Maternal Behaviors and Joint Attention

In line with our hypothesis, positive maternal behaviors were positively associated with the duration of JA episodes (see Table 4). More sensitive mothers spent more time in JA with their infants in terms of both total duration (r =.63, p < .001) and average duration (r = .44, p = .002). Similarly, mothers' cognitive stimulation was positively related to the total (r = .55, p < .001) and average duration (r = .30, p = .04) of JA episodes. Finally, mothers who showed more positive affect had JA episodes that lasted longer on average (r = .32, p = .03) and in total (r = .52, p < .001). As expected, negative behaviors correlated with the duration of the episodes as well. Mothers who exhibited more negative affect during their interactions with their infants spent less time in JA in total (r = -.37, p = .01) and on average (r = -.32, p = .03). Mothers' controlling behaviors were not related to the duration of the episodes.

Another hypothesis was that positive behaviors would be positively associated with the percentage of JA episodes initiated by mothers' following of infants' attentional focus. Similarly, we expected negative behaviors to be positively associated with the percentage of episodes initiated by mothers' directing of infants' attention. Results partially supported these hypotheses. By whom the episodes were started was not associated with any of the positive maternal behaviors (i.e. sensitivity, cognitive stimulation, and positive affect). However, we found that mothers' controlling behaviors were negatively correlated with the percentage of JA episodes initiated by maternal following (r = -34, p = .019) and positively correlated with the percentage of episodes initiated by maternal directing (r = .34, p = .019).

Regarding the termination of the episodes, we expected positive maternal behaviors to be negatively associated with the percentage of episodes terminated by the mother. Our findings supported this hypothesis as mothers who were more sensitive terminated JA

episodes less (r = -.42, p = .003). The termination of the episodes was not related to any other maternal behaviors.

We hypothesized that positive maternal behaviors would be positively correlated with the percentage of coordinated episodes and negative maternal behaviors would be negatively related to the percentage of passive JA episodes. We found that maternal sensitivity was positively related to the percentage of coordinated JA (r = .31, p = .03) and negatively related to the percentage of passive JA (r = -.31, p = .03). This characteristic of the episodes was not related to any other maternal behavior.

Finally, the frequency of JA episodes was not associated with any of the maternal behaviors.

3.2. Maternal Behaviors, Joint Attention and Infants' Language

We examined the relationship between vocabulary scores of infants and each characteristic of the JA episodes (see Table 4). We expected infants' vocabulary to be positively associated with the duration of the JA episodes, the percentage of coordinated episodes, and the percentage of episodes started by maternal following. Results of the Pearson correlation analyses confirmed all of these hypotheses. The length of the average time mother-infant dyads spent in JA was positively correlated with expressive vocabulary scores of infants (r = .31, p = .048), but not related to their receptive vocabulary scores. Contrary to average duration, the total time dyads spent in JA was not related to the infants' receptive and expressive vocabulary.

The percentage of coordinated episodes was positively correlated with infants' expressive vocabulary (r = .32, p = .03) but was not related to their receptive vocabulary. In a similar fashion, the percentage of passive JA episodes was negatively related to infants'

expressive vocabulary (r = -.32, p = .03) but was not related to their receptive vocabulary. As expected, the percentage of episodes initiated by maternal following was positively associated with infants' vocabulary. This association was significant for infants' expressive vocabulary (r = .39, p =.01) but not for their receptive vocabulary. Complementing this, the percentage of JA episodes initiated by maternal direction was negatively correlated with expressive vocabulary (r = -.39, p = .01), but not related to receptive vocabulary. We did not observe a significant relationship between infants' vocabulary and the frequency of JA episodes, and how the episodes were terminated.

To see whether maternal behaviors are related to the language scores of infants, we conducted Pearson correlation tests. Results indicate that maternal sensitivity level was significantly correlated with expressive vocabulary scores of infants (r = .32, p = .04), but not with receptive vocabulary (r = .25, p = .11). Other maternal behaviors, cognitive stimulation, positive/negative affect, controlling, were not associated with either expressive or receptive vocabulary knowledge of infants (all p's > .05).

3.3. Mediating Role of Joint Attention between Maternal Behaviors and Infants' Language

We conducted simple mediation analyses in which we tested the mediating role of JA between maternal behaviors and language scores of infants via Process Macro extension of IBM SPSS in which bootstrap procedure was used with 5000 resampling (Preacher & Hayes, 2008). We carried out the analyses only with the variables having significant relationships with each other. Since expressive language scores were significantly correlated with average duration of JA episodes, the percentage of JA episodes initiated by maternal following/direction and the percentage of passive/coordinated JA episodes, we examined the relationship of these variables among maternal behaviors and expressive language. In these

models, maternal behaviors were assigned as predictors, JA characteristics were assigned as mediators, and expressive language scores were assigned as dependent variables. All mediation analyses were conducted twice with total maternal language input and maternal language input provided inside the JA episodes as control variables.

We conducted four separate simple mediation analyses for the mediating role of average JA durations in the link between maternal behaviors (sensitivity, positive/negative affect and cognitive stimulation) and language scores while using the amount of maternal language input as a covariate. Results of the first simple mediation analysis indicated that an overall regression model predicting expressive vocabulary scores of infants from mothers' sensitivity level and average JA durations was not significant, $F(3,38) = 3.12$, $p = .08$, $R^2 = .16$. The indirect path from sensitivity to expressive vocabulary scores via JA average duration also was not significant (indirect effect coefficient = 7.93, *SE* = 11.24, 95% BCA-CI =-10.44, 32.65). The second simple mediation analysis revealed that regression model predicting expressive vocabulary scores of infants from mothers' positive affect levels and average JA durations was marginally significant ($F(3,38) = 2.68$, $p = .06$, $R^2 = .17$) and the specific indirect path was not significant (indirect effect coefficient = 6.02, *SE* = 8.57, 95% BCA-CI =-3.66, 28.72). Third, for the model predicting expressive scores of infants from mothers' negative affect levels through JA average durations, the model did not reveal a significant regression model ($F(3,38) = 1.58$, $p = .20$, $R^2 = .11$) and indirect effect (indirect effect coefficient = -7.29, *SE* = 7.33, 95% BCA-CI =-24.47, 2.53). Lastly, the regression model and the indirect effect predicting the expressive vocabulary of children from mothers' cognitive stimulation levels through average duration of JA episodes were not significant, $F(3,38) = 1.64$, $p = .19$, $R^2 = .11$; indirect effect coefficient = 9.06, *SE* = 8.52, 95% BCA-CI =-2.79, 28.37; see Table 5 and 9 for simple mediation results, direct and indirect effects).

Results did not change when maternal language input only inside the JA episodes was controlled.

Table 5.

Results of Simple Mediation Analyses for Maternal Behavior, Joint Attention Mean Duration and Language Scores

	Joint Attention Average Duration				Expressive Language Scores			
Predictors	path	*β*	SE	*p*	path	*β*	SE	*p*
Sensitivity	*a*	14.15	4.83	.005	*c'*	22.55	14.46	.12
Language Input	*f*	.01	.03	.71	*f*	-.09	.08	.32
JA-Mean Duration	-	-	-	-	*b*	.56	.08	.31
		R^2 = .20				R^2 = .16		
		F(2,39) = 4.84, *p* = .01				*F*(3,38) = 2.43, *p* = .08		
Pos. Affect	*a*	9.08	5.41	.10	*c'*	24.93	14.12	.08
Language Input	*f*	.009	.03	.79	*f*	-.11	.08	.18
JA-Mean Duration	-	-	-	-	*b*	.66	.40	.10
		R^2 = .08				R^2 = .17		
		F(2,39) = 1.89, *p* = .16				*F*(3,38) = 2.68, *p* = .06		
Neg. Affect	*a*	-9.18	4.56	.05	*c'*	-5.29	12.72	.67
Language Input	*f*	.03	.03	.37	*f*	-.06	.08	.47
JA-Mean Duration	-	-	-	-	*b*	.79	.42	.06
		R^2 = .11				R^2 = .11		
		F(2,39) = 2.52, *p* = .09				*F*(3,38) = 1.58, *p* = .20		
Cogn. Stimul.	*a*	9.96	6.01	.10	*c'*	-9.33	16.21	.56

Language Input	*f*	.01	.03	.72	*f*	-.04	.09	.61
JA-Mean Duration	-	-	-	-	*b*	.91	.41	.03
		R^2 = .09				R^2 = .11		
		F(2,39) = 1.85, *p* = .16				*F*(3,38) = 1.64, *p* = .19		

Note. Abbreviations: JA = Joint Attention, Cogn. Stimul. = Cognitive Stimulation

How JA episodes were initiated, whether via maternal following or maternal direction, was found to be significantly related to only controlling behaviors of mothers. Results of a simple mediation model indicated that overall the regression model did not explain a significant amount of variance in expressive vocabulary knowledge of infants from maternal controlling behaviors and percentage of JA episodes initiated by maternal following (*F*(3,39) = 2.36, *p* = .08, R^2 = .15). However, indirect path from maternal controlling levels to infants' expressive language scores through JA episodes started by maternal following was significant (indirect effect coefficient = -11.04, *SE* = 4.86, 95% BCA-CI =-22.50, -3.58). Similarly, indirect effect of maternal control levels on expressive language scores of infants through percentage of JA episodes initiated by maternal direction was significant (indirect effect coefficient = -11.04, *SE* = 4.69, 95% BCA-CI =-22.31, -3.58; see Figure 1). Therefore, mothers who were more controlling started the JA episodes by directing the attentional focus of the infants rather than following it, and in turn, the expressive vocabulary knowledge of these children were less. Moreover, as the mediator of this model, the percentage of JA episodes initiated by maternal following or maternal direction accounted for 63 % of the total effect (Indirect effect/Total effect; P_M = .63; see Table 6 and 9 for simple mediation results, direct and indirect effects). Results did not change when maternal language input inside the JA episodes was controlled.

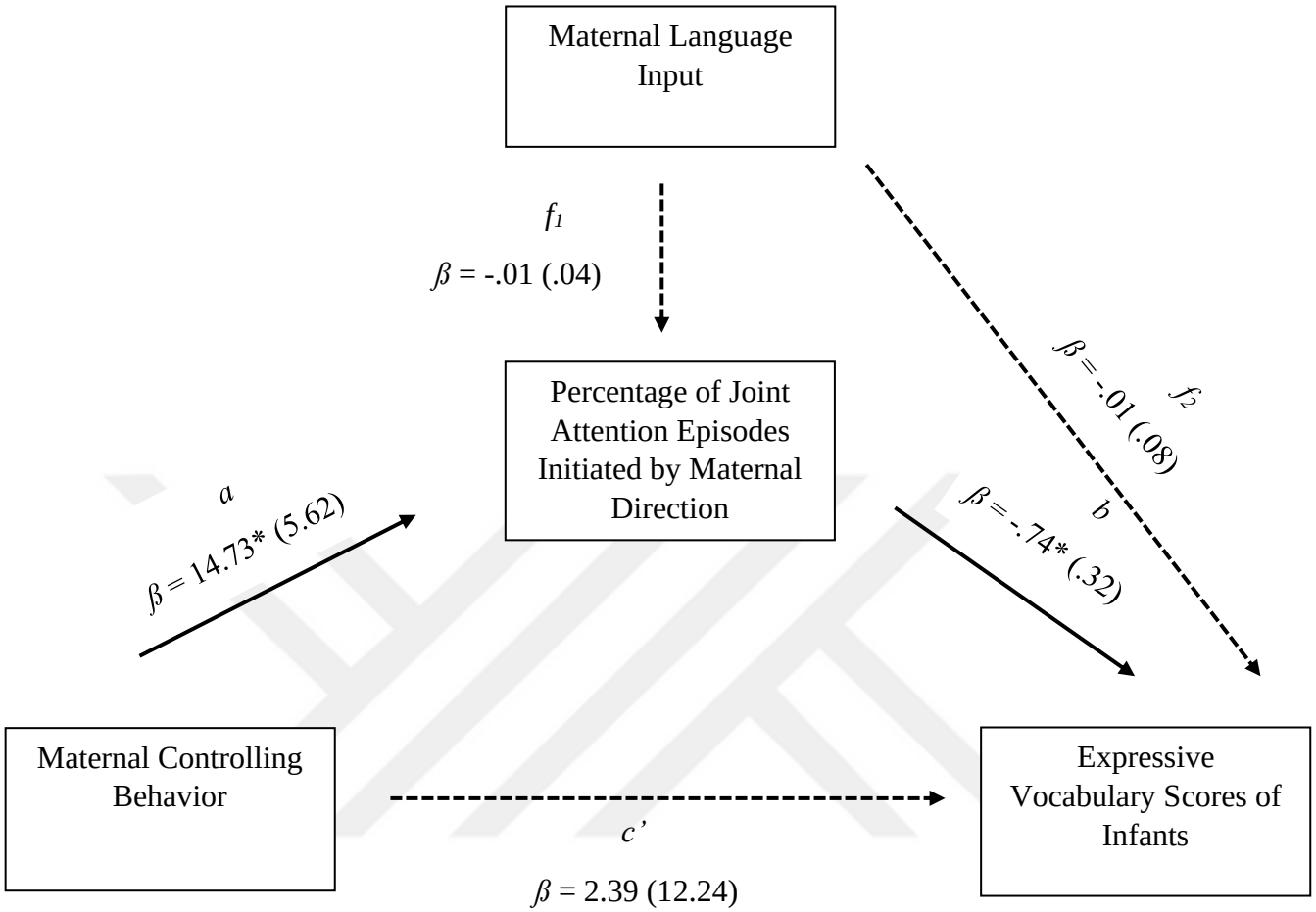
Table 6.

Results of Simple Mediation Analyses for Maternal Behavior, Percentage of Joint Attention Initiated by Maternal Follow-in or Maternal Direction and Language Scores

	JA Initiated by Maternal Following / Maternal Direction				Expressive Language Scores			
Predictors	path	*ß*	SE	*p*	path	*ß*	SE	*p*
Controlling	*a*	-14.73	5.62	.01	*c'*	-2.39	12.24	.84
Language Input	f_1	.01	.04	.90	f_2	-.01	.08	.86
JA Ini. by Maternal Following					*b*	.74	.32	.02
		R^2 = .15 $F(2,40) = 3.51$, $p = .03$				R^2 = .15 $F(3,39) = 2,36$, $p = .08$		
Controlling	*a*	14.73	5.62	.01	*c'*	-2.39	12.24	.84
Language Input	f_1	.01	.04	.90	f_2	-.01	.08	.86
JA Ini. by Maternal Direction	-	-	-	-	*b*	-.74	.32	.02
		R^2 = .15 $F(2,40) = 3.51$, $p = .03$				R^2 = .15 $F(3,39) = 2,36$, $p = .08$		

Note. Abbreviations: Ini. = Initiated.

Figure 1. Effect of maternal controlling on expressive language scores through joint attention episodes initiated by maternal direction when maternal language input is controlled



Note. * < .05. Bold lines indicate significant relationships and dashed lines indicate nonsignificant relationships.

Whether the JA episodes were passive or coordinated was significantly correlated with sensitivity levels of mothers. Overall the regression model predicting infants' expressive language scores from sensitivity through the percentage of coordinated/passive JA episodes was marginally significant ($F(3,39) = 2.61$, $p = .06$, $R^2 = .17$), however the indirect path did not reveal a significant effect (indirect effect coefficient for coordinated JA episodes= 6.82, *SE* = 5.34, 95% BCA-CI =-1.01, 19.35; indirect effect coefficient for passive JA episodes= 6.82, *SE* = 5.43, 95% BCA-CI =-1.08, 19.96; see Table 7 and 9 for simple mediation results,

direct and indirect effects). Results did not change when maternal language input only inside the JA episodes was controlled.

Table 7.

Results of Simple Mediation Analyses for Maternal Behavior, Percentage of Coordinated Joint Attention and Language Scores

	Coordinated JA				Expressive Language Scores			
Predictors	path	*ß*	SE	*p*	path	*ß*	SE	*p*
Sensitivity	*a*	13.66	6.33	.04	*c'*	22.83	13.61	.10
Language Input	f_1	-.01	.04	.75	f_2	-.06	.08	.44
Coordinated JA	-	-	-	-	*b*	.50	.32	.13
		R^2 = .10				R^2 = .17		
		$F(2,40) = 2.33$, $p = .10$				$F(3,39) = 2.62$, $p = .06$		

Note. Abbreviations: JA = Joint Attention.

3.4. Relationship between Maternal Education Level and Infants Language Development through Maternal Behaviors and Characteristics of Joint Attention Episodes

Maternal education level was found to be significantly correlated with all maternal behaviors measured in this study (sensitivity; $r = .35$, cognitive stimulation; $r = .30$, positive affect $r = .41$, negative affect; $r = -.37$, controlling; $r = -.36$; all p's $< .05$). However, it was not correlated with any characteristics of JA episodes and language scores of infants (see Table 4 for all correlations). We conducted a serial mediation model in which maternal education level was the predictor, maternal behavior was the first mediator, characteristics of JA episodes was the second mediator and expressive vocabulary scores was the dependent variable. Since the only significant simple mediation model was between maternal controlling, percentage of JA episodes initiated by maternal following/direction and infants'

expressive language knowledge, we conducted the serial mediation model with these variables.

Results of serial mediation model showed that the overall regression model predicting expressive language scores of infants from maternal education levels through maternal controlling levels and percentage of JA episodes initiated by maternal direction was not significant ($F(4,37) = 1.95$, $p = .12$, $R^2 = .17$). Further, the indirect effect of this model was significant (indirect effect coefficient = .64, *SE* = .46, 95% BCA-CI =.05, 1.80; see Figure 2). Since percentage of JA episodes initiated by maternal direction and maternal following was mutually exclusive and yielded the same results, findings regarding maternal following were not reported here. The effect size of these models is $P_M = .25$. See Table 8 and 9 for serial mediation results, direct and indirect effects. Results did not change when maternal language input inside the JA episodes was controlled.

The serial mediation model for the indirect effect of maternal education via maternal sensitivity and percentage of coordinated JA episodes was not significant ($F(4,37) = 2.03$, $p = .10$, $R^2 = .18$). The indirect effect of this was marginally significant (indirect effect coefficient = .34, *SE* = .39, 95% BCA-CI = -.06, 1.37). Percentage of passive and coordinated JA episodes was mutually exclusive and yielded the same results and findings regarding maternal passive JA were not reported here. The effect size of these models is $P_M = .14$. Results did not change when maternal language input only inside the JA episodes was controlled.

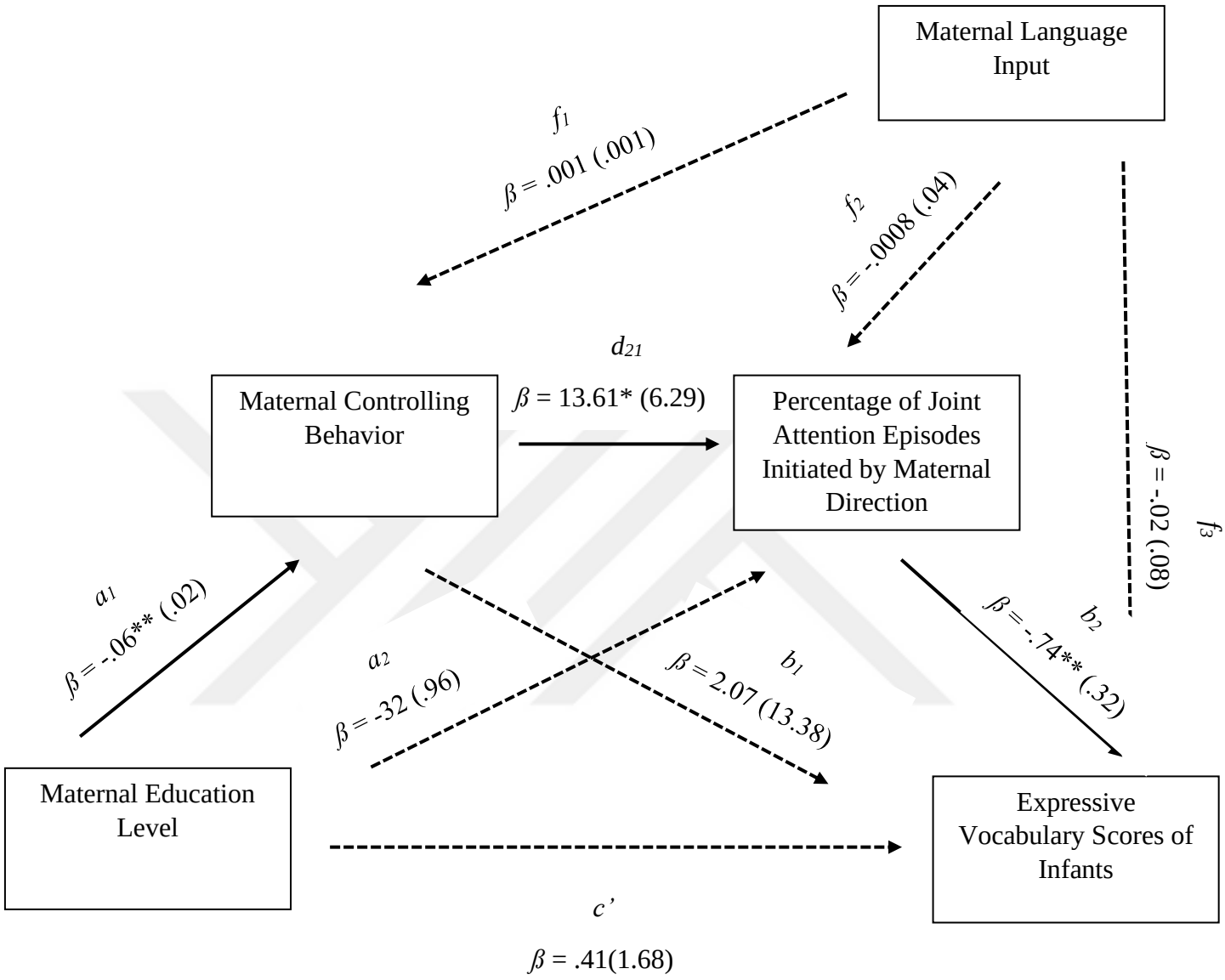
Table 8.

Results of Serial Mediation Analyses for Maternal Education Level, Maternal Behavior, Percentage of Joint Attention Initiated by Maternal Follow-in or Maternal Direction and Language Scores

	Controlling				JA Initiated by Maternal Direction				Expressive Language Scores			
Predictors	path	*ß*	SE	*p*	path	*ß*	SE	*p*	path	*ß*	SE	*p*
Language Input	f_1	.001	.001	.14	f_2	-.0008	.04	.98	f_3	-.02	.08	.77
Maternal Education Level	a_1	-.06	.02	.007	a_2	-.32	.96	.74	c'	1.77	1.94	.37
Controlling	-	-	-	-	d_{21}	13.61	6.29	.03	b_1	2.07	13.38	.87
JA Ini. by Maternal Following	-	-	-	-	-	-	-	-	b_2	-.74	.32	.02
			R^2 = .20				R^2 = .15				R^2 = .17	
			$F(2,39) = 4.92$, $p = .01$				$F(3,38) = 2.22$, $p = .10$				$F(4,37) = 1.95$, $p = .12$	

Note. Abbreviations: Ini. = İnitiated.

Figure 2. Effect of maternal education level on expressive language scores through maternal controlling behaviors and joint attention episodes initiated by maternal direction when maternal language input is controlled



Note. * < .05. Bold lines indicate significant relationships and dashed lines indicate nonsignificant relationships.

Table 9.

Direct and indirect effects of the independent variable on the dependent variable.

	β	SE	LLCI	ULCI
Direct effect of sensitivity on expressive language scores	22.55	14.46	-6.71	51.83
Indirect effect of sensitivity on expressive language scores through joint attention average duration*	7.93	11.30	-10.49	32.89
Direct effect of positive affect on expressive language scores	24.93	14.12	-3.65	53.53
Indirect effect of positive affect on expressive language scores through joint attention average duration*	6.02	8.43	-4.21	27.91
Direct effect of negative affect on expressive language scores	-5.29	12.72	-31.06	20.46
Indirect effect of negative affect on expressive language scores through joint attention average duration*	-7.28	7.24	-24.92	2.44
Direct effect of cognitive stimulation on expressive language scores	-9.33	16.21	-42.16	23.48
Indirect effect of cognitive stimulation on expressive language scores through joint attention average duration*	9.06	8.35	-2.92	28.49
Direct effect of controlling on expressive language scores	-2.39	12.24	-27.15	22.36
Indirect effect of controlling on expressive language scores through joint attention initiated by maternal following*	-11.04	4.77	-22.50	-3.89
Indirect effect of controlling on expressive language scores through joint attention initiated by maternal direction*	-11.04	4.86	-22.50	-3.89
Direct effect of sensitivity on expressive language scores	22.83	13.60	-4.68	50.36
Indirect effect of sensitivity on expressive language scores through percentage of coordinated joint attention episodes*	6.81	5.26	-1.05	19.52

Direct effect of maternal education level on expressive language scores	1.77	1.94	-2.17	5.71
Indirect effect of maternal education level on expressive language scores through maternal controlling behaviors and percentage of joint attention episodes initiated by maternal direction *	.64	.46	.04	1.76

Note. *. Bias-corrected standard error and bootstrap confidence intervals. LLCI and ULCI indicate lower and upper level confidence intervals.

4. DISCUSSION

The primary goal of this study was to investigate whether maternal behaviors and certain features of JA between mothers and infants at 12 months mediate the link between maternal education levels and language development of infants at 14 months. Moreover, we tested the association between maternal behaviors and characteristics of JA episodes. Serial mediation model results indicated that maternal controlling behavior and JA episodes initiated by maternal direction mediated the relationship between maternal education levels and expressive language scores of infants. Duration of JA episodes was positively correlated with sensitivity, cognitive stimulation and positive affect while it is negatively related to negative affect levels of mothers. Percentage of JA episodes initiated by maternal direction was correlated with control behaviors. Further, percentage of coordinated and mother-terminated JA episodes was positively related to sensitivity levels of mothers. Findings also revealed that the average duration of JA episodes and the percentage of coordinated JA episodes in mother-infant interactions at 12 months were positively associated; the percentage of JA episodes initiated by maternal direction was negatively related to expressive vocabulary knowledge of infants at 14 months.

Even though positive association between establishing JA in caregiver-infant dyads and language development is well-established, this study is the first attempt to test both

qualitative and quantitative features of JA episodes on language development of infants. Findings of the current study revealed that the percentage of JA episodes initiated by maternal following was positively correlated with infants' expressive vocabulary knowledge while maternal direction was negatively correlated. This result reaffirms the findings of both observational and experimental studies of Tomasello and Farrar (1986). They found that children learned more words when the mothers started the JA interactions by following the current focus of infants compared to the times they started JA by redirecting the attention of infants. Carpenter et al., (1998) also found that degree of mothers' use of following language, in which they commented about the objects or events that are already inside the focus of infants, had a positive association with word knowledge of infants. These findings suggest that interrupting the focus of children and making them attend to a new focus of attention might be detrimental for word learning. When children try to shift their attention to a new place directed by another person, this might create a cognitive load and be more difficult for them to connect what they hear to what they see. Further, the percentage of coordinated JA episodes was positively related to expressive vocabulary scores of infants. This result confirms that being aware of the simultaneous focus of the mother reinforces learning the object names for children (e.g., Baldwin, 2000). During coordinated attention, children can be aware of what the adult sees and talks about; they can directly link the word reference provided by the adult to an object or event. Building upon previous studies, this study is the first one measuring the average duration of the JA episodes in mother-infant interactions and found a positive relationship of this variable with prospective vocabulary knowledge of infants. The possible reason of positive relationship with the language scores of infants might be related to the time infants sustained their attention during JA episodes. In their recent study, Yu, Suanda and Smith (2019) found that percentage of time infants spent in sustained attention in the context of JA during mother-infant interaction at 9 months predicted infants'

vocabulary sizes at 12 and 15 months. Therefore, when JA episodes are not interrupted and last longer, infants might have time to sustain their attention which helps them to learn the words for objects and events. These JA variables are related to the expressive vocabulary scores, but not to the receptive scores. As Tomasello and Mervis (1994) stated, compared to the expressive language, detecting and reporting the receptive vocabulary of the infants at early ages might be difficult for the parents. For this reason, expressive vocabulary scores of infants might be more accurate and more likely to reveal a significant relationship with the JA episodes' features, as we found in this study.

Findings about the relationship between frequency of JA episodes during parent-child interaction and language development are mixed. In line with some previous studies, the current study did not reveal a significant association between JA episodes' frequency and vocabulary scores of infants. Markus et al. (2000) found that frequency of JA episodes during mother-infant free play interaction at 18 months was not correlated with expressive and receptive vocabulary scores of infants at 18, 21 and 24 months. On the other hand, Loy et al. (2018)'s study indicated that total number of JA episodes in dyadic interaction at 13 and 17 months is positively linked to the vocabulary knowledge of infants at 17 months. These mixed results point that not the frequency, but the quality and duration of each JA episodes could be related to the infants' language learning. Instead of short and frequent JA episodes, less frequent and longer JA episodes might be effective for children to learn the vocabulary. Different from the findings of the present study, previous studies found the positive effect of JA total durations during caregiver-infant interactions with language development of infants (Carpenter et al., 1998; Markus et al., 2000). The possible reason of this contradictory finding could be linked to differences in coding of JA in the studies. While the current study counted both passive and coordinated JA interactions as JA incidences, previous studies only counted the coordinated attentional focus of caregivers and infants as JA. Therefore, summing the

duration of passive and coordinated JA episodes may not reveal a significant effect on language learning. To our knowledge, this study is the first one in the literature looking at whether proportion of times mothers or infants finish the JA episodes is correlated with language scores. Results did not reveal an association between language scores of infants and termination of JA episodes by any of the partners. In terms of termination, we only examined by whom the episodes ended. Timing and the attentional state of infant during the termination might be more meaningful to investigate the association of JA termination to language outcomes.

Characteristics of JA episodes have been found to be related to different maternal behaviors. Duration of JA episodes was related to sensitive, cognitive stimulation, positive and negative affect behaviors of mothers, but not related to controlling levels. As in the previous studies, sensitiveness has positive effects on JA episodes such as more sensitive mothers spend more time in JA (Raver & Leadbeater, 1995) and engaged in higher levels of shared commitment (Londoño & Farkas, 2018). Because sensitive mothers follow the attentional focus of their children and provide the necessary responses to them, these behaviors might encourage the children and increase the eagerness for the ongoing activity and in turn, the JA interactions might last longer. In line with this finding, Mason et al. (2018) found that 5-month-old infants who received high levels of sensitive behaviors from their mothers preferred to look at the objects in the hands of their mothers more frequently compared to infants whose mothers showed a high ratio of directive behaviors. Similarly, mothers who try to cognitively stimulate and teach their children engage in age-appropriate learning activities which might increase the encouragement of infants and in turn, spent more time in JA interactions. Mothers' positive affect such as praising and complimenting the children might reinforce children for the activity and exploring the objects in front of them. On the contrary, negative affect by the mothers such as expressing discontent and displeasure

might decrease the interest of the children for the events and objects. Therefore, JA episodes last longer in the dyads with more positive affect while they last shorter in dyads with more negative affect. Lastly, controlling levels have not been found to be related to duration of the JA episodes. Rather than affecting the duration, controlling behaviors of mothers might influence the quality of JA episodes and type of interaction between mother and infants.

How JA episodes were initiated was only related to controlling levels: Controlling mothers started the episodes by maternal direction more frequently and by maternal following less frequently. This finding confirmed the study of McQuillan, Smith, Yu, & Bates (2019) which showed that when mothers are instructed to lead the joint play with their infants, they act more controlling and intrusively. These results suggest that there is a tight relationship between mothers' controlling levels and their behaviors in following or directing the attentional focus of children. Findings also point that there might be a bidirectional relation between mothers' behaviors and their manners during parent-child interaction. Thus, the style and characteristics of the interaction might also influence caregivers' behaviors. Sensitivity levels of mothers has not been found to related to how JA episodes were initiated. The definition of sensitivity does not always include following the attentional focus of the child, but sometimes sensitive mothers reorient the attention of the child to another place. By redirecting the focus of the children, sensitive mothers make them to disengage from one stimulus and reorient to a new one, which in turn, helps children to explore their environment (Pecheux, Findji, & Ruel, 1992). Since sensitive mothers redirect the attentional focus of the child when needed, sensitivity levels of the mothers may not be related to how JA episodes were initiated. Cognitive stimulation, positive and negative affect levels of the mothers were not correlated with how the episodes started. These behaviors are about how the mothers manage the game, what kind of games they play during the JA episodes and how they keep

the child engaged during the play. For this reason, these behaviors could be related to the quality and duration of JA episodes rather than how they were initiated.

Who ended the JA episodes and whether the dyads engaged in passive or coordinated JA were only related to the sensitivity levels of the mothers. Sensitive mothers are more willing to keep the engagement with their children and that may be why they did not end the JA episodes until their children terminated them. Further, sensitive mothers also know what the child desires to play so that they can engage in turn-taking games. Further, as Bigelow, MacLean & Proctor (2004) demonstrated in their study, when the mothers display sensitive behaviors, children became more likely to play more functional and relational games. While dyads engage in turn-taking games, children become more likely to coordinate their attention between their caregivers and objects. Cognitive stimulation, positive/negative affect and controlling behaviors were not related to either by whom the episodes ended or whether dyads engaged in passive or coordinated JA interactions. In contrary to sensitivity, maternal behaviors of cognitive stimulation, positive and negative affect do not aim to follow the focus of the child and engage in reciprocal game. Instead, these behaviors include teaching about the objects and expressing the emotions during the play. Hence, these behaviors might not be correlated with by whom the episodes ended and whether they engaged in coordinated play or not. Controlling behaviors of mothers might make infants to end the interaction in some cases since they did not want to play the game that were suggested by the mothers. Therefore, they might have ended the games as well as their mothers. Similarly, controlling mothers might force infants to play turn-taking and reciprocal games where sometimes infants reply and sometimes not. On the other hand, the total number of episodes were not related to any of the behaviors. Five-minute play may not be a long enough time duration to detect the differences and variation across the dyads. During the five minutes, mothers who are inclined to display both negative and positive behaviors want to engage and play with their infants. Therefore,

instead of the frequency, duration and style of each episode might be influenced by the maternal behaviors. This study also indicated that maternal behaviors and JA are distinct processes that are related to each other. While maternal behaviors are shaped in line with their interaction styles and expectations from their children, joint attention is a two-person process in which both maternal and child characteristics and skills play a role. Current and previous studies demonstrated that specific maternal behaviors influence the attention development and attention processes in mother-infant interactions.

Maternal controlling behaviors influenced the language scores of infants through features of JA episodes. In detail, mothers who are more controlling started the JA episodes by directing the attention of the child and in turn, expressive vocabulary knowledge of their children were smaller than less controlling mothers. The indirect effect of maternal characteristics on child outcomes has been shown in previous studies. For example, McCarty and McMahon (2003) showed that maternal depressive symptoms predict children's disruptive behavior disorder through problematic parent-child interactions. Studies in language development also revealed the mediator role of parent-child relationships. These studies showed that maternal language abilities influence the child language development through their sensitive and controlling behaviors (Prime, Wade & Gonzales, 2019; Taylor, Donovan, Miles, & Leavitt, 2009). These findings indicate that parental characteristics have an effect on child outcomes such as language development via the quality of parent-child interactions.

How socioeconomic status, specifically education levels of parents, are related to the child development has been widely studied. In line with the recent findings, the current study revealed the indirect effect of maternal education level on language development of infants. Mothers' from lower educational backgrounds acted in a more controlled way and initiated the JA interactions by directing rather than following the focus of their children which

resulted in lower expressive vocabulary scores. Abels and Hutman (2015) showed that infants from families with lower SES are more inclined to follow the points of others compared to infants from higher SES families. They proposed that families with lower SES levels aim to socialize their children as more obedient and less autonomous, and their children become more inclined to obey and follow adults' attentional cues. Findings of the current study suggested that, mothers with lower education might teach their children to be more obedient by acting more in a controlling way and establishing JA interactions by directing the focus of their children. Studies of Hoff (2003) and Huttenlocher et al. (2010) also showed that SES levels of mothers predict the language development of children through the quantity and quality of maternal speech. These results are in line with the models argued in the child development field which suggest that SES levels of the families influence the child developmental outcomes via parenting and parent-child interactions (e.g., Family Stress and Family Investment Models; Conger & Donnellan, 2007; Johnson et al., 2016; Perkins et al., 2013). Since children learn the language in the social context, and generally from their caregivers and family members, how this social context is shaped and established for the children is an important issue that should be studied further. The current study is one of the attempts to reveal how maternal SES affects language development of children via parenting style and parent-child interactions.

4.1. Strengths, Limitations, and Future Studies

Current study investigated the role of maternal education level and specific maternal behaviors on the relationship between JA episodes in mother-infant interaction and language development of infants. This study has remarkable strengths with its longitudinal design and detailed coding systems. We examined the interaction of the dyads and caregivers' behaviors when the infants were 12 months old and then we followed up the infants at 14-months to measure their vocabulary knowledge. Further, apart from previous studies, various aspects of

maternal behaviors were coded to see differential role of each on JA episodes. The characteristics of JA episodes were also coded in detail with both their quantitative and qualitative features and their differential effects on the language development of infants were investigated. Coding these two constructs by different coders increases the reliability and power of the study. Observing the caregiver-infant interaction in a lab environment, in the same room, with the same toys and in a limited time allows us to detect the differences in maternal behaviors and mothers' interaction with their infants across the dyads. Mediation analysis is a powerful way to detect the relationship between study variables which allows researchers to understand the mechanisms of child development. SPSS macro of Preacher and Hayes (2008) is robust way to analyze the indirect relationships with its resampling method of bootstrapping. Therefore, although the sample size of the study is relatively small, bootstrapping method in which the study sample is considered as the representation of the population and many resamples are generated from the study sample to conduct the analysis of interest allows us to rely on the findings (Preacher & Hayes, 2004). Previous studies also examined the mediator role of different variables in the relationship of maternal and child characteristics to language development with small sample sizes (e.g., Hellendoorn et al., 2015; Huttenlocher et al., 2010; Hoff, 2003; Taylor et al., 2009).

There are some limitations of the study. We measured the vocabulary scores of infants through maternal report at a very early age where infants just start uttering words and show the signs that they understand words. Even for the mothers, it could be difficult to observe their vocabulary, especially receptive knowledge of infants. A more direct measurement such as Looking While Listening paradigm (Fernald, Zangl, Portillo, & Marchman, 2008) would be a better way to detect the vocabulary scores of the infants. Observing the maternal behaviors and JA characteristics in the same free play interaction might be a weakness. Even though free play is a structured environment and provides insight about caregivers' attitudes

during their interaction with children, five-minute free play only promises us to measure the momentary behaviors of the caregivers. Therefore, examining the maternal behaviors in a less structured environment and in a longer time might be more meaningful to observe the stable behaviors of mothers toward their children. Further, since mothers were not instructed to behave in a certain way, we cannot deduce that some behaviors elicit certain characteristics of JA characteristics. Also, direction of the relationship between maternal behaviors and features of JA episodes might be two-way. As the study of McQuillan et al. (2019) indicated, the features of JA episodes might shape the behaviors of the caregivers such as when they were instructed to lead the play with their children, they became more intrusive and controlling. Thus, by using experimental paradigms, further studies should focus on the bidirectional relationship between parental behaviors and JA interactions.

Future studies should also focus on how these specific maternal behaviors help regulation and development of children's JA skills. As shown in the study of Landry et al. (1997), controlling behaviors of mothers are related to children's later age of emergence in response to their mothers' attention requests. Medically high-risk children with more controlling mothers showed lower rates of increase in their initiating JA ages compared to children with less controlling mothers. Moreover, JA is a two-person interaction and sometimes mothers might regulate their own behaviors during JA interaction according to children's ability to sustain and reorient their attention. Therefore, individual differences and needs of children might lead caregivers to behave differently toward their children. As Dynamic Systems Theory suggests, development is not linear and stable all the time (van Geert, 2011). As environment shapes the child outcomes, characteristics of children also shape the environment. Hence, future studies should focus on whether child skills and characteristics during parent-child interaction influence the parental behaviors and JA episodes. Child attention abilities such as point following and JA initiation can be tested via

Early Social Communication Scale (Mundy et. al., 2003) and included in the models testing how maternal behaviors and JA skills of children together influence the parent-child JA interactions and language development of children. Lastly, even though the current study examines various aspects of maternal behaviors, differential effects of other verbal (contents of language used) and nonverbal (gestures, facial expressions) behaviors of the dyads should be studied in detail.

5. CONCLUSION

The current study inquired whether specific maternal behaviors and characteristics of joint attentional interactions mediated the link between maternal education levels and language development of infants. We demonstrated that mothers from higher educational backgrounds displayed controlling behaviors less and initiated the joint attention episodes by following the focus of their infants, which in turn predicted the expressive vocabulary knowledge of infants. Further, we demonstrated that maternal behaviors play an important role in managing and determining the characteristics of joint attention interactions. Lastly, we partly replicated the findings regarding the association between joint attention characteristics during mother-infant interaction and language development. Future studies should shed light on which other factors in parent-child interaction play a role in the mechanism underlying the effect of social environment on language development of children.

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