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Abstract

We investigated the continuity and stability of imitative episodes (IMEs) to shed light on the nature of early infant imitative ability. We observed and analyzed interactions of 27 mother-infant pairs as they played in their homes at one and 10 months. We coded the initiator, frequency, duration, kind, structure, and affect of IMEs. At 10 months, dyads engaged in more frequent and longer IMEs that tended to be vocal, turn-takings, and positive in affect. Significant stability was observed. Mothers who initiated more IMEs and expressed more positive affect had infants who did the same. Findings suggest that dyads set stable communication patterns early on, even though all of these variables increased significantly over time. These patterns may be driven or be highly influenced by early individual differences in communicative ability. Findings also imply that building a history of positive exchanges may be critical in demonstrating stability in imitative episodes.

Keywords: imitation, infancy, mother-infant interaction, longitudinal, stability, intersubjectivity.

Developmental Changes in Imitation during Mother-Infant Interactions

Current thinking about infant imitation centers on the origins of imitative ability. Although researchers agree that imitation supports the developing ability to communicate, self-regulate, and learn, they disagree on whether infant imitation is truly a voluntary act and whether the ability to imitate is innate (Poulson, Reginade, Nunes, & Warren, 1989). Such disagreement can potentially be enlightened by examining the development of infant imitation in the first months of life. Furthermore, the context in which infant imitation is studied as well as the research design (longitudinal versus cross-sectional) are important factors to consider in order to address issues of continuity and stability in imitation, which in turn would inform the nature and origins of this phenomenon (Suddendorf, Oostenbroek, Nielsen, & Slaughter, 2013). In this study, we followed the changes in imitation from one to 10 months of age during playful mother-infant interactions to explore the continuity of imitative ability and to inform the reality and significance of these early interactions.

Neonatal imitation has sparked a perennial debate, particularly in the last 35 years (Oostenbroek, Slaughter, Nielsen, & Suddengorf, 2013). Meltzoff and Moore (1994) have argued that infants are born with the knowledge necessary to imitate other people's acts such as tongue protrusion. Infants are able to represent the modeled behavior and then activate the respective body parts to imitate. Early imitation is, therefore an innate social skill that allows the creation of early social interactions (Kugiumutzakis, 1998; Kugiumutzakis, & Trevarthen, 2015; Oostenbroek, et al., 2013). This claim is bolstered by research focusing on the existence of the human mirror system as evidence of the innate ability to imitate (Iacoboni, 2005). Relying on mirror neurons removes the need of representational ability in newborns. All is needed is a simple motor action program that is activated by mirror neurons (Jones, 2009). Critics, however,

argue that evidence from other species suggests that mirror systems are activated only when the action is purposeful, such as reaching out to grab food. The acts that human newborns have imitated in experimental studies (e.g., tongue protrusion) lacked such meaning. Furthermore, researchers have yet to identify mirror neurons in newborns (Jones, 2009).

Another interpretation of imitation is that it is simply a reflexive behavior, which tends to fade away along with other reflexes when the motor cortex matures in the first 6 months of life. Evidence for this position comes from experimental studies on imitation of tongue protrusion, the most reliably shown imitative act (Oostenbroek, et al., 2013). From this perspective, early imitation is not necessarily linked to later imitation or other social behaviors later on. Lastly, imitation is seen as a response to arousal. Jones (2006) demonstrated that infants engaged in greater tongue protrusion when they were interested, although other researchers showed tongue protrusion with non-human arousing stimuli (Chen, Reid, & Striano, 2006). However, this research is limited in that it does not explain imitation of other behaviors. The most recent claim is that infants' developing imitative ability of various acts depends on increasing motor skills and knowledge of the world (Osstenbroek et al., 2013).

In reaction to this debate, researchers questioned the context in which infant imitation was studied (Simpson, Murray, Paukner, & Ferrari, 2014), arguing that experimental settings limit the infants' intention to communicate. The imitative mind of infants emerges from their intersubjective communication with people who love and care for them (Trevarthen, 1979; Trevarthen, Kokkinaki, & Fiamenghi, 1999). The birth of intesubjectivity is regulated by positive emotions so that defining imitation has been recently turned from "a simple reproduction of a model's action" (Piaget, 1962, p.2) to "the sharing of more or less the same actions, intention,

motivation, and emotions between two communicating partners" (Kugiumutzakis, Kokkinaki, Markodimitraki, & Vitalaki, 2005, p. 176).

Spontaneous imitative phenomena have been systematically studied by a Cretan research team led by Kugiumutzakis (Kokkinaki, 1998; Markodimitraki, 2003; Pateraki, 2011; Pratikaki, 2009; Vitalaki, 2002). Their findings are based on analyses of imitative responses as they naturally occurred in mother-infant interactions but not at the level of the individual. The results showed that maternal initiations were more frequent, that imitations were predominantly vocal with more vowel than consonant imitations, that most imitative episodes involved simple turn takings, and that episodes lasted between 1.7 to 1.9 seconds. Findings regarding the developmental path of imitative episodes vary depending on the kind of imitation. Regarding vocal imitation, results showed an increase of infant imitation from 2 to 3.5 months and an increase of maternal imitations from 1.5 up to 2.5 months (Kugiumutzakis, 1993). In addition, Kokkinaki's (1998) findings showed that vocal imitations in interactions with female infants fluctuated across the whole age range of the 8th week to the 24th week, while in interactions with male infants, they rose from the 8th to the 16th week, at which age-point a downward trend begun. Non-linear developmental curves of imitation in mother-infant interactions were also confirmed by Vitalaki (2002) and Markodimitraki (2003). The latter showed a stable fluctuating trajectory of vowel imitation with peaks in 3rd, 6th and 8-10 months.

In a review study, Suddendorf et al. (2013) concluded that the evidence for imitation being the basis of later social cognitive skills was inadequate and argued that if that was the case infants with higher rate of neonatal imitation should demonstrate higher frequency of imitation later on. This calls for longitudinal studies that focus on "intra-infant consistency and stability of imitative episodes across testing sessions" (p. 55). With the exception of the Cretan team, the

researchers who attempted to study neonatal imitation longitudinally did so by assessing infant responses to models instead of observing natural occurrences of imitation in the context of family interactions that are filled with emotions.

From the perspective of intersubjectivity, the emotional climate in which imitative exchanges take place is very important (Kärtner, Holodynski, & Wörmann, 2013; Kokkinaki, 1998; Kokkinaki & Kugiumutzakis, 2000; Kugiumutzakis, 1993, 1998, 1999; Kugiumutzakis et al. 2005; Trevarthen, Kokkinaki, & Fiamenghi, 1999; Wörmann, Holodynski, Kärtner, & Keller, 2012). Early imitation "swims" in emotions (Kugumutzakis, et al. 2005, p. 172) with the more predominant emotions to have been interest, pleasure (Kokkinaki, 1998) and a mixture of the two emotions (Markodimitraki, 2003). Microanalysis of mother-infant interactions showed that the emotional matching preceded, accompanied and followed the reproduction of the models' actions in natural interactions (Kugiumutzakis et. al., 2005).

The current study is grounded on the understanding, as supported by the evidence presented here, that infants can engage in imitative communication right from birth, because they have their own intentions, motives, actions, emotions, and the desire and ability to share them with their caregivers. We designed a naturalistic longitudinal study and analyzed IMEs at the individual level of the infant in order to capture the intra-infant consistency. We focused on the changes that happened from one month to 10 month of age in order to observe significant change, as children reach the pre-verbal period. In addition, unlike previous studies, we focused on emotions that accompanied imitation. Based on the cumulative findings of the researchers at the Cretan lab, we predicted that mothers would be the most frequent initiators in imitative exchanges but infants would significantly increase initiations of imitation over time (Kugiumutzakis et. al. 2005). Moreover, because of the dialogic form of early imitative

exchanges (Trevarthen, 1977, 1979), we predicted that turn-taking that is shown to predominate very early in infant's life (Kokkinaki, 1998; Kugiumutzakis, 1985, 1999) would continue to predominate almost before the end of the first year, when infants become more mature social partners. Additionally, as vocalizations heave the weight of imitations early in life (Kokkinaki & Kugiumutzakis 2000; Kugiumutzakis, 1999; Kugiumutzakis et. al. 2005), we also predicted that they would continue to do so during the tenth month of life where first signs of language development appear and imitation comes to serve its learning function as well. With respect to duration, we expected a significant increase over time especially for turn taking because at 10 months partners could better predict each other's intentions and motives and would know how to prolong an interesting imitative exchange. We also expected to observe an increased matching of affect over time. Lastly, we predicted stability in characteristics of imitative exchanges because such findings confirm the reality and significance of established early interactions that are necessary for infants to develop a sense of security during the first year of life.

Method

Participants

Participants were 27 Caucasian, middle class, mothers and their infants from the island of Crete, Greece. They were part of a larger study that also included mother and twin infant pairs. Here, only mother and non-twin pairs were included. The infants (13 boys and 14 girls) were all first-born, full-term, and healthy babies born in modern maternity hospitals in four prefectures of Crete. Sixteen of the infants were delivered vaginally and 11 infants were delivered by caesarian section. Pregnancy, duration of labor, and perinatal factors were within typical limits. The infants' mean gestational age was 39.5 weeks (range: 36-38). The infants' mean birth weight was

3.283 gr (range: 2.680-3.900) and the average birth height was 51.7 cm (range: 49-55). The mean Apgar score was 7.2 (range = 6-9) at the first minute and 9.4 (range: 8-10) at the fifth minute. At the beginning of the study, the mothers' mean age was 25.2 years (range: 20-36). The infants were breastfed for an average period of 4 months (range: 1.5-8). The majority of the mothers (81%) was employed and had a college degree (78%). The mean age of the fathers' was 30.3 years (range: 24-37), 85% had a college degree and all were employed. All employed mothers were on parental leave during the duration of this study. All infants were typically developing during the duration of the study.

This project received approval by the institutional review board of the University of Crete. Data collection for the broader study was completed in 2006. The families were recruited through the obstetricians and midwives offices during the mothers' prenatal check-up visits. They were given a pamphlet of information about the study. Those showing an interest in participating were contacted via phone 15 days after delivery. Just before infants turned one month old, researchers visited the families to introduce themselves and explain further details concerning the study. Parents were told that the aim of the study was the investigation of the ways through which mothers communicated with their infants. All families who were contacted agreed to participate.

Procedure

Mothers and infants were observed interacting with each other during 10 study visits, one for each month, starting when the infants were one-month old till they were 10-month old. Visits took place at a time convenient to the family, but always half hour following a feed, when infants were most likely to be relaxed and alert for interpersonal interaction (Markodimitraki, 2003). Each interaction every month lasted for 7 minutes and all interactions were video recorded by a

digital camera recorder. The mothers were instructed to play with their child as they normally did at home. The recordings took place in a room and a position chosen by the mothers (e.g., on a sofa, on infant's bed, infant's seat mostly in nursery or in the living room). The interactions did not involve any other family members. All visits took place as scheduled. At the completion of the study the parents were interviewed in order to confirm that they had not understood the real purpose of the study. None of them was aware that imitation was under study. Participants were given a Thank You card and a copy of the video-taped interactions for their keepsake. No other compensation was offered.

Coding[1]

In the present study, an imitative episode (IME) was defined as a period from the moment that the model's first expressive act started until the completion of the imitator's last imitative activity. More specifically, imitation was defined as a social act in the course of which one partner expresses an act that had not been expressed by either partner in the immediately preceding 10 seconds, and in which the other partner reproduced within an interval of less or equal to 10 seconds. The response period of 10 seconds has been deemed to be adequate for imitation tests with infants (Heimann & Ullstadius, 1999; Kokkinaki, 1998; Kokkinaki & Kugiumutzakis, 2000; Kugiumutzakis, 1993; Markodimitraki, 2003; Pateraki, 2011; Pratikaki, 2009; Trevarthen, 1977; Vitalaki, 2002). We micro-analyzed in 1/25 of second infant's and mother's vocal/verbal/non verbal and kinetic expressive behaviors during the 7-minute

[1] Coding was competed in December 2007. In the span of 2006 and 2010, the first author used the data to compare the imitation of twin and non-twin infants with their mothers and presented findings at conferences and published them in Greek psychological journals. In these previous examinations, the unit of analysis was the imitative episodes that occurred from one month to 10 months. In the present study, the authors used the existing coded data to focus on the non-twin-mother pairs and reconfigured the variables to be able to examine the longitudinal change within the infant.

interactions. Coding under this micro-analytic technique was related to the following basic aspects of imitation:

The *direction* of the imitative episode indicating who the initiator was. The partner (mother or infant) who started an expressive act that had not been expressed by either partner in the immediately preceding 10 seconds and which was reproduced by the other partner within an interval of less or equal to 10 seconds was scored as *initiator* of the IME.

(a) *Kinds* of imitation for mothers and infants was scored according to the following categories and subcategories: (a) *sound imitations* including vowels or vowel-like sounds (e.g., /a/, /ae/, /ai/, /ao/, /au/, /e/, /o/, /ou/, /u/, /ua), consonants or consonant-like sounds (e.g. /g/, /m/, /mh/, /h/), combinations of sounds (e.g., /ag/, /agu/, /am/, /abu/, /aha/, /ma/, /ta/, /ho/, /ha/), and non-speech sound imitation (e.g., sneezing, yawning, sighing, and crying); (b) *body movements* including facial expression imitation such as tongue protrusion, opening-closing of the mouth, and blinking and other movements such as hand movements, clapping hands, and pointing movements; (c) *body movements involving objects*; and (d) combinations of sound and body categories.

(b) The *structure* of the imitative episode was analyzed to capture the timing between the model's and the imitator's expressive behavior. The structure had the following three categories in which IMEs were taking place: (a) *turn taking* where pause between turns was no longer than 10 seconds; (b) *co-action* (the imitation of an expressive behavior overlapped with the completion of the model's expressive action (Kokkinaki, 1998; Kuhgiumutzakis, 1985); (c) multiple exchanges consisting of turn-taking(s) and co-action(s).

(c) The total *duration* of turn-taking, co-action, and multiple exchanges were also recorded.

(d) *Affect* during the IMEs. We coded the occurrence of positive (e.g., pleasure, interest), negative (e.g., sadness, anger), and neutral affect of mothers and infants (Kokkinaki, 1998;

Markodimitraki, 2003) before, during, and after each imitative episode. Pre-imitative zone lasted 10 seconds right before the beginning of each IME. Post-imitative zone lasted 10 seconds right after the end of each IME. Imitative zone was defined as the zone where each IME occurred.

The data used in the analyses were frequencies or durations of the codes. For the purpose of this study, we used data from the first and last visit because the sample size would not allow a meaningful longitudinal analysis of multiple time points. Reliability was based on the coding of a randomized selection of 33% of the data that was done by the first author and a research assistant, who was blind to the research hypotheses. Inter-coder reliability was then calculated using *Cohen's kappa*. The average value for *kappa* based on all variables was .87 (range: .84 - .89).

Results

Overview of Analyses

We first conducted descriptive analyses for all study variables that describe IMEs: frequency, duration, initiator (mother or infant), structure (turn-taking, coactions, combinations), kind (sound, body, involving toy), and affect (negative, neutral, positive) before, during, and after the IMEs. Because the frequency of negative and neutral affect during IMEs was very low we did not include these variables in the following analyses. In order to examine change over tome, we conducted a series of independent t-tests with the above variables from Time 1 to Time 2. To examine continuity, we correlated the study variables from Time 1 to Time 2. All analyses were conducted at $a = .05$.

Longitudinal Change in IMEs

As expected, the number of IMEs significantly increased over time, $t(20) = 3.14$, $p = .005$. As seen in Table 1, both mothers and infant initiated more IMEs at Time 2 than Time 1, but

the difference was only significant for infants, $t(20) = 3.86$, $p = .001$. When examining the structure of the IMEs, both turn-taking and co-actions significantly increased, $t(20) = 2.54$, $p = .019$ and $t(20) = 2.14$, $p = .047$, respectively. Lastly, the duration of turn-taking and co-actions increased from Time 1 to Time 2, $t(20) = 3.11$, $p = .005$ and $t(20) = 2.32$, $p = .031$, respectively (Table 1).

In terms of the content of IMEs, at Time 2, the dyads engaged in significantly more IMEs that involved sounds, $t(20) = 2.41$, $p = .025$. There was no significant change in IMEs that involved body movements (Table 1). We also found a significant increase in positive affect of mothers, $t(20) = 3.22$, $p = .004$, and infants, $t(20) = 4.60$, $p = .001$, during the imitative episodes. This increase in maternal positive affect was also significant before, $t(20) = 3.06$, $p = .006$ and after the imitative episode, $t(20) = 3.09$, $p = .003$. Infants too showed significantly more positive affect before the imitative episodes, $t(20) = 3.49$, $p = .002$, and after, $t(20) = 3.31$, $p = .003$ (Figures 1, 2).

Longitudinal Stability in IMEs

As shown in Table 2, the number of IMEs showed considerable stability over time, $r = .73$, $p < .001$. Mothers who initiated more IMEs at 10 months did so earlier, $r = .64$, $p = .002$. The structure of IME showed stability whether it was a turn-taking, $r = .57$, $p = .007$ or coaction, $r = .44$, $p = .04$, and dyads who engaged in longer turn-taking IMEs continued to do so at 10 months, $r = .58$, $p = .006$. There was also continuity in positive affect during IMEs of mothers, $r = .73$, $p < .001$, and, infants $r = .71$, $p < .001$. Dyads who engaged in IMEs involving vocal sounds showed stability, $r = .73$, $p < .001$. In contrast, IMEs with bodily movements did not show continuity. Overall, these results are consistent with our predictions.

Concurrent Analyses at Time 1 and Time 2

As expected, mothers initiated more IMEs than infants did at Time 1, $t(20) = 3.86$, $p < .001$, and Time 2, $t(20) = 3.86$, $p < .001$, respectively. Moreover, the dyads engaged in significantly more turn taking than co-actions at Time 1, $t(20) = 3.86$, $p < .001$ and Time 2, $t(20) = 3.86$, $p < .001$. The duration of turn taking was longer than the duration of co-actions at Time 1 and Time 2. The duration of turn taking was longer than the duration of co-actions at Time 1 and Time 2.

Mothers who initiated more IMEs tended to have infants who also initiated more IMEs at Time 1, $r = .39$, $p = .06$. This relationship approached significance at Time 2, $r = .35$, $p = .07$. Lastly, mothers who showed more positive affect during IMEs had infants who also showed more positive affect at Time 1, $r = .87$, $p < .001$ and Time 2, $r = .95$, $p < .001$ during the IMEs. This was the case for positive affect before, Time1, $r = .79$, $p < .001$, Time 2, $r = .52$, $p < .01$ and after the imitative episode, Time 1, $r = .80$, $p < .001$, Time 2, $r = .97$, $p < .001$.

Discussion

The purpose of this naturalistic longitudinal study was to investigate the developmental changes of early imitation. Despite the well-evidenced relationship between both mothers' and infants' imitation and children's subsequent cognitive and language development (e.g., Bloom, Hood, & Lightbown, 1974; Masur, Flynn, & Eichorst, 2005; Tamis-LeMonda, Bornstein, & Baumwell, 2001), current knowledge about spontaneous imitative interactions in the early months is relatively limited. The present study is among very few to investigate naturally occurring interactions. We predicted an increase in imitative exchanges in terms of frequency and duration. We also predicted that turn-taking and vocal imitations would increase over time. Lastly we expected continuity and stability in frequency, duration, and structure of imitative episodes.

The findings largely supported our predictions. Mothers and infants engaged in more frequent IMEs and the duration of these exchanges increased over time. Moreover, the dyads that were likely to frequently engage in such interactions at one month did so at 10 months. Duration also showed continuity. There were additional characteristics of these interactions that showed continuity over time. Mothers who initiated more IMEs at 10 months did so earlier, and had infants who initiated more imitation at one month. The structure of IMEs showed stability whether it was a turn-taking or coaction, and dyads who engaged in longer turn-taking continued to do so at 10 months. Altogether, these findings suggest that dyads set fairly stable patterns of communication early on even though all of these variables increased significantly over time. These patterns may be driven or highly influenced by early individual differences in communicative ability. Evidence supports the idea that patterns of infant-mother communication has a history that is characterized by stability. Specifically, during the first six months of life, as infants grow older they and their mothers consistently engage in more symmetrical interactions such as imitation (Hsu & Fogel, 2003).

Our findings contradict evidence from Oostenbroek et al. (2016) who failed to show consistent imitation from 1 to 9 weeks after birth. In essence, infants tended to respond in the same way invariably of the modeled behavior. For example, infants showed tongue protrusion at the same rate when the model demonstrated tongue protrusion or a happy face. The authors interpreted this as lack of evidence of neonatal ability to imitate and suggested instead that infants become capable of imitation sometime between 6 and 8 months. There are several concerns about such interpretation. First the theories that support innate ability to imitate are based on the notion of intersubjectivity, a state that is characterized by shared social and emotional meaning. In Oostenbroek et al. (2016), this was clearly not the case. The experiment

was conducted in a laboratory and the exchange with the stranger lacked emotion. Infants tend to modulate mimicry based on social cues (de Klerk, de Hamilton, & Southgate, 2018) and it is possible that infants did not perceive social cues in this strange situation. Second, it is possible that stability in imitative behaviors is evident over a longer period of time such as the age span of 9 months examined here. Stability over time is an outcome of consolidating mechanisms needed to consistently demonstrate a behavior. Lastly, Oostenbroek et al. (2016) did not account for any attempts infants might have made to initiate imitation, thus making these interactions quite asynchronious from the perspective of the infant.

In our naturalistic observations, we observed continuity in positive affect during IMEs of mothers and infants. This was not the case for negative or neutral emotions, which were infrequent. Moreover, positive affect increased significantly over time, as expected. When we examined the affect of the dyads before, during, and after IMEs we found similar levels of positive affect. These results support the longitudinal importance of positive affect in instigating and maintaining IMEs (Kokkinaki, 2003). These findings also imply that building a history of positive exchanges may be critical in demonstrating stability in IEMs.

Dyads who engaged in IMEs involving vocal sounds showed stability and a significant increase thus, indicating continuity between imitating prespeech sounds and imitating verbal sounds (Kugiumutzakis, 1999). In contrast, IMEs with bodily movements did not show continuity, most likely due to infant growing linguistic ability and encouragement from parents. Recent research demonstrated an increase in vocal imitation among infants, whose mothers provided contingent vocal responses during the period of 4 to 14 months of age (Palaez, Borroto, & Carrow, 2018).

The current findings support the claim that imitation is present at birth and that studying interactions in a natural context is critical in finding continuity in IMEs. However, it is still unclear what the underlying mechanism supporting such continuity is. Buck (2017) suggested that infant imitation might just be spontaneous communication where infants automatically and unconsciously match behaviors of their caregivers. Buck (2017) also suggested that such interactions are influenced by oxytocin. Similarly Campos and Nieto (2017) consider infant imitation as mimicry that does not require any cognitive symbolism but just a social context to develop. Consistent repetition solidifies the foundation for more complex interactions that is true imitation. In the early weeks, mimicry may be seen as evidence of positive, mutual interactions and an index of the caregiver's sensitivity in responding to infant cues. This explanation fits the continuity findings we observed in this study.

Future research may replicate these findings in a larger longitudinal study that takes place in a naturalistic context. It is important to account for infant attempts to initiate interactions as well as to consider emotional affect during imitative exchanges (Kokkinaki, et al., 2005). To expand this research, interactions with other family members is warranted (Kokkinaki & Pratikaki 2014, Kokkinaki & Vitalaki, 2013). Lastly, individual characteristics such as temperament and regulation of sensory stimulation may be influencing the readiness of infants to engage with the caregiver in imitative acts because individual differences in early behavioral responses influence interactions with caregivers (Rettew, Stanger, McKee, Doyle, & Hudziak (2006).

Altogether, results show both qualitative and quantitative change in imitative exchanges as well as continuity during playful mother-infant interactions over the first year of life, thus, affirming the presence of infant ability to imitate others and initiate imitation early on.

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Table 1

Contrast of Imitation Variables from One-Month to 10-Months

	One-Month		10-Month				*CI*	
Variable	*M*	*SD*	*M*	*SD*	*t*(20)	*p*	*UL*	*LL*
Number of IME	4.62	3.93	7.43	5.95	3.14	**.005**	4.67	.94
Mother as Initiator	4.24	3.56	5.57	5.14	1.55	1.36	3.12	.45
Infant as Initiator	.38	.66	1.86	1.85	3.86	**.001**	2.27	.68
Number of Turn-Takings	2.62	2.22	4.38	3.86	2.54	**.01**	3.20	.31
Number of Co-Actions	1.29	1.55	2.29	2.34	2.14	**.04**	1.98	.01
Number of Combinations	0.71	1.05	0.76	0.99	.16	.871	0.66	.554
Duration of Turn-Taking[a]	7.95	8.24	18.43	18.67	3.11	**.005**	17.49	3.45
Duration of Co-Action[a]	5.33	7.10	12.19	13.8	2.32	**.03**	13.00	.70
Duration of Combinations	5.29	9.47	9.00	13.89	1.01	.323	11.35	3.92
IME Involving Sounds	3.19	3.58	5.04	4.74	2.41	**.02**	3.46	.25
IME Involving Body	1.23	1.37	1.95	1.98	1.19	.24	1.96	.53
Mother's Positive Affect[b]	4.52	3.94	7.38	5.96	3.22	**.004**	4.70	1.00
Mother's Negative Affect[b]	0.10	0.43	0.10	0.30	0.00	1.00	.249	.249
Mother's Neutral Affect[b]	0.00	0.00	0.05	0.21	1.00	.329	.147	0.05
Infant's Positive Affect[b]	2.57	2.63	6.71	5.58	4.60	**.000**	6.02	2.26
Infant's Negative Affect[b]	.81	1.25	.33	1.11	-1.19	.248	1.31	1.35
Infant's Neutral Affect	1.24	1.33	.38	.66	-2.90	**.009**	1.47	0.24

Note. $N = 21$; [a]Duration is shown in seconds, [b]Number of times affect was present during

IMEs.

Table 2

Correlations of Imitation Variables from One-Month to 10-Months

	r
Number of IME	.73**
Mother is Initiator	.65**
Infant as Initiator	.33
Number of Turn-Takings	.57**
Number of Co-Actions	.44*
Duration of Turn-Taking[a]	.58*
Duration of Co-Action[a]	.30
IME Involving Sounds	.67**
IME Involving Movements	-.30
Infants' Positive Affect Pre Imitation Zone	.59**
Mothers' Positive Affect Pre Imitation Zone	.72***
Infants' Positive Affect in Imitation Zone	.72***
Mothers' Positive Affect in Imitation Zone	.73***
Infants' Positive Affect Post Imitation Zone	.64**
Mothers' Positive Affect Post Imitation Zone	.74***

Note. $N = 21$; $p^{**} < .01$, $^{*}p < .05$

Figure 1.

Positive Affect of Mothers before, during, and after Imitative Episodes

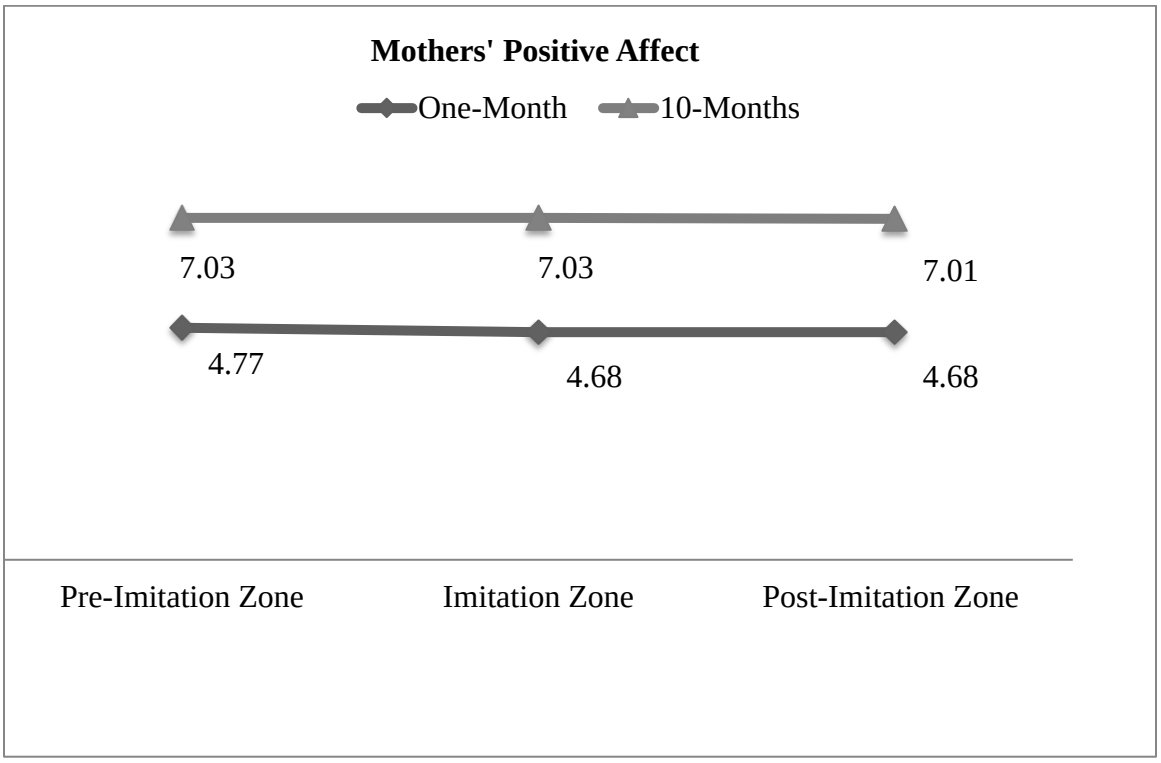

Figure 2.

Positive Affect of Infants before, during, and after Imitative Episodes