

Research Reports

Emotional Expressions in Grandparent-Infant Grandchild Interaction in the Course of the First Year of Life

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Abstract

This longitudinal and naturalistic study aims to describe and compare grandparent and infant emotional expressions that precede, accompany and follow spontaneous imitation in the course of their dyadic interaction. Sixteen Greek, Cretan infants were video-recorded in the course of spontaneous dyadic interactions with grandfathers and grandmothers at home from the 2nd to the 10th month of their life. Microanalyses of grandmothers', grandfathers' and infant grandchildren's emotional expressions within well-defined units of interaction provided the following evidence: (a) Grandparents increased pleasure-interest expression while single pleasure and interest decreased in the course of imitation. Grandparent neutral expression remained stable, at low levels, before, during and after imitation. Grandfathers were more interested than grandmothers and grandmothers expressed more pleasure-interest towards their infant grandchildren, compared to grandfathers; (b) Similar patterns of infant grandchildren's emotional expressions in interactions with grandfathers and grandmothers provided evidence that infant interest predominated over the remaining expressions before imitation, it decreased in the course of it and it increased after it. Infant pleasure remained stable before and in the course of imitation and decreased slightly after it. Infant pleasure-interest expression increased and neutral expression decreased in the course of imitation. Infants were more neutral in interactions with their grandfathers, compared to grandmothers, particularly in the course of the first age level (2 to 3.5 months); (c) Infant age correlated with certain infants' and grandparents' emotional expressions. This evidence reinforces the view that grandparents are communicative partners to their infant grandchildren.

Keywords: imitation, emotional expressions, grandfathers, grandparents, inter-generational relations

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Introduction

The aim of this study is to describe and compare grandparent and infant emotional expressions that precede, accompany and follow spontaneous imitation (the reproduction of an expressive behavior) in dyadic grandfather- and grandmother-infant grandchild imitation in the course of the first year of life. This study may advance our understanding of the way in which infants, without being able to speak, share an understanding of what they, and first-generation significant others, mean by what they do and say (Trevarthen, Kokkinaki, & Fiamenghi, 1999; Waldrop, Weber, Herald, Pruett, Cooper, & Juozapavicius, 1999).

One of the main theoretical perspectives aiming to explain the reasons and the ways through which grandparents contribute to their grandchildren's lives comes from evolutionary psychology (Coall & Hertwig, 2010, 2011). The grandmother hypothesis suggests that grandmothers may be the most motivated helpers for their reproductive daughters and their grandchildren. In this way, maternal grandmothers improve their grandchildren's health and

chances of survival, while a negligible impact has been evidenced for the maternal grandfather in the first two years of life (Hrdy, 1999, as cited in Coall & Hertwig, 2010; Sear & Coall, 2011; Sear, Mace, & McGregor, 2000). Another kin-based explanation is paternity uncertainty which refers to the risk that a male is not the biological father of his children. Because the maternal grandmother is certain of her relationship with her daughter and her daughter's relationship with her grandchildren, it is predicted that maternal grandmothers will invest the most (Coall & Hertwig, 2010). In urban Greece (modern Western society), maternal grandmothers were rated as more caring than grandfathers. Nevertheless, it is assumed that similarly to fathers, grandfathers care for their grandchildren but our evolutionary history has shown male care to be considered less essential than female care (Pashos, 2000). Within an alternative Darwinian view, the proximate cause for why grandparents care for the welfare of their grandchildren may lie in their capacity for empathy. Empathy constitutes a rapid emotional connectedness mechanism, through which an organism gains access to the subjective state of another organism. Empathy alerts grandparents to their kin's needs, helps them to identify emotionally with them and provides them with psychological benefits by giving support (Coall & Hertwig, 2010); for a review of other theoretical perspectives (such as economic and sociological), see Coall & Hertwig (2011).

Recently, Coall and Hertwig (2010, 2011) suggested that the beneficial effects of grandparental investment (resources that grandparents transfer to their grandchildren) may be found in dimensions such as psychological adjustment, cognitive and verbal ability, mental health and well-being (Sear & Coall, 2011). One dimension of grandparental resources is the "...emotional support provided by a listening ear..." (Coall & Hertwig, 2011, p. 93). Sear and Coall (2011) adopt Hrdy's speculation (2009) according to which changing patterns of kin association and childcare may lead to a decline in our ability to empathize with and cooperate with others, or: "Compassion and the quest for emotional connection will fade away..." (Hrdy, 2009 (p. 293), as cited in Sear & Coall, 2011, p. 104). In order to expand our understanding of grandparental help, "...one key moderating variable is the quality of the grandparent-grandchild emotional relationship in general and the quality of their face-to-face interactions in particular" (Coall & Hertwig, 2011, p. 96).

The motives behind an affectionate partner interacting with an infant, and vice versa, are further discussed in the framework of the theory of innate intersubjectivity (Trevvarthen 1993, 1997, 1998, 2005). Within this theoretical framework, culture is propagated by learners' (e.g. infants) and teachers' (e.g. grandparents) active mimicry and constitutes a generation-to-generation conversational, intersubjective process in which the learners make an active contribution (Trevvarthen et al., 1999). There is evidence that imitation in infant-significant other interaction constitutes an example of innate intersubjectivity. This is a dynamic process that allows emotions to be transferred between (inter-subjectivity) and within minds (intra-subjectivity) (Kokkinaki, 1998, 2003; Kugiumutzakis, Kokkinaki, Markodimitraki, & Vitalaki, 2005; Trevvarthen, 1993, 2005).

The limited number of studies on the grandmother-grandchild relationship focus on 0 to 59 month old grandchildren and examines the effect of the maternal grandmother on child health improvement and survival probabilities (Sear, Mace, & McGregor, 2000). These studies also look into the relationship between the grandmother's involvement and infant attachment behavior (Myers, Jarvis, & Creasey, 1987), the grandchild's social adjustment (Barnett, Neppi, Scaramella, Ontai, & Conger, 2010), anger (Brook, Tseng, Whiteman, & Cohen, 1998), independence and adaptive responding (Tomlin & Passman, 1989). Meanwhile, the grandfather's role has been documented based on generalized descriptions of certain aspects of grandparents who are raising their grandchildren (demographic profile, conditions that led them to take on the parental role, stresses and satisfactions) (Thomas, Sperry, & Yarbrough, 2000).

Within the framework of the theory of innate intersubjectivity, there is evidence that Greek, Cretan grandmothers, as well as grandfathers, offer infants a sense of partner *stability* with similar and predictable actions and inter-actions while, at the same time, they also offer a *variety* of challenging communication. It has been assumed that grandfathers are as capable and sensitive as imitators and communicative partners as grandmothers and parents are (Kokkinaki, Germanakis, & Pratikaki, 2012; Pratikaki, Germanakis, & Kokkinaki, 2011). Markodimitraki's (2003) case study provided evidence that in the course of spontaneous imitation in dyadic twin infant-parent/grandparent interactions (1st to 10th month of infants' life), pleasure and pleasure-and-interest expressions (see Coding) increased, while interest and neutral expressions decreased. This study does not provide information on similarities/differences in interactions between infants and maternal grandmothers and grandfathers since descriptive analysis was carried out for adults' emotional expressions.

Tinsley and Parke (1987) observed grandparents and parents in individual five-minute dyadic play sessions (with toys provided by the experimenter) with their 7-month-old infants in the parents' homes. Results indicated that both grandmothers and grandfathers are active, interactive support agents with a pattern of similarities and differences in interactive style across generation and gender. Grandchildren of grandparents who engaged in more stimulating behaviour and infants who had more contact with their grandparents achieved higher Bayley Mental Development Index scores.

With no intention to underestimate the value of these studies, Tinsley and Parke's study (1987) lacks the longitudinal investigation of interactional dynamics of spontaneous infant-grandparent interaction in the course of infancy. Generalizing Markodimitraki's (2003) evidence to other dyads is limited, because this was a case study in which the longitudinal development of all partners' emotional expressions was descriptive rather than statistically analyzed. Kokkinaki et al. (2012) and Pratikaki et al.'s studies (2011) would benefit from the systematic investigation of grandparents' and infants' spontaneous emotional expressions.

The current study makes a range of improvements on the methodology of the previous studies. Using a sample from Greece (Heraklion in northern Crete), the aim of this study was to describe and compare grandparents' and infants' facial expressions of emotions that precede, accompany and follow spontaneous imitation in dyadic grandfather- and grandmother-infant grandchild imitation from the 2nd to the 10th month of the infant's life. In this study, imitation was identified when an individual's expression (vocal, kinetic, facial expression or any combination of these), in a form that had not been expressed by either partner in the immediately preceding 10 seconds, is reproduced by his or her partner within a 10-second interval (Kokkinaki, 1998, 2003; Pratikaki, 2009). This study addresses the following hypotheses:

- **Hypothesis (1):** (1a) grandparents' and infants' positive expressions (pleasure, interest and pleasure-interest) will predominate over neutral and negative expressions; (1b): infants' and grandparents' pleasure and pleasure-interest expressions will increase, while neutral emotions will decrease in the course of imitation. These hypotheses are based on the findings from dyadic interactions between a pair of twin infants and their maternal grandmother and grandfather (Kugiumutzakis et al., 2005; Markodimitraki, 2003).
- **Hypothesis (2):** there will be similarities and differences in grandmothers' and grandfathers' emotional expressions towards their infants, and vice versa, before, during and after imitation. Certain aspects of imitation reinforce its intersubjective function according to which imitation constitutes the dynamic process that allows emotions to be transferred between minds (Kokkinaki, 1998, 2003; Trevarthen, 1993, 1998). This hypothesis indirectly arises from the evidence of similarities and differences in certain aspects of imitation, found in the interactions between

infants and their maternal grandmothers and grandfathers (Kokkinaki et al., 2012; Pratikaki, 2009; Pratikaki et al., 2011).

• **Hypothesis 3:** infant age will correlate with grandparents' and infants' emotional expressions before, during and after imitation. Markodimitraki's (2003) descriptive analysis provided evidence that from the 1st to the 10th month of the infants' life, there was a steady increase in the pleasure and pleasure-interest expression and a decrease in neutral expression. Furthermore, from the 2nd to the 6th month of the infants' life, the developmental course of infant pleasure and interest during vocal imitation correlated with the infant's age (Kokkinaki, 2003).

If these hypotheses are confirmed, they will reinforce the evidence that, early in life, both grandparents constitute communicative partners in relation to their infant grandchildren (Kokkinaki & Vitalaki, 2013a, 2013b; Kokkinaki et al., 2012; Pratikaki et al., 2011).

Studying emotional expressions in grandparent-infant grandchild interactions in a Greek, Cretan sample is important because: (a) Grandparent-grandchild relationships serve a crucial function in the well-being of all generations (Coall & Hertwig, 2011). With increasing longevity, grandparents and grandchildren have more of a shared lifespan than ever before (Murphy & Grundy, 2003, as cited in Coall & Hertwig, 2011). Thus, the need for grandparents to invest their affection in their grandchildren may actually be stronger than ever (Coall & Hertwig, 2011). Giving and receiving affection from younger generations and the process of sharing life experiences can help grandparents maintain internal continuity and create a sense of integrity and purpose in life – a key element in preserving an internal balance needed for successful aging (Atchley, 1989, 1992, as cited in Waldrop et al., 1999). Recent research outside the grandparenting context suggests that extended contact of this kind may be particularly influential in intensifying interpersonal intimacy (Harwood, 2000); (b) The grandparental role is a culturally relevant phenomenon and different social environments not only affect grandparental caregiving but largely determine it (Lou & Chi, 2012; Pashos, 2000). Greece fits the Western economic development model and, since the early 1980s, lifestyle practices in northern Crete seem to be susceptible to a transformation in favour of an urban, Western culture. Cretans suggest that traditional gender stereotypes may be breaking down, though they appear to expect more traditional behavior of older women (and probably men) than they expect from the younger generation (Terkenli, Bellas, & Jenkins, 2007). Despite the fact that the older generation is gradually disappearing (Legg & Roberts, 1997, as cited in Terkenli et al., 2007), grandmothers often care for grandchildren if daughters or daughters-in-law are employed. The extended family unit still holds strong as the central point of reference, and extended families ensure that their rural and urban components remain in regular contact, thus preserving the ties between the two at all costs (Terkenli et al., 2007). The maintenance of strong and long-standing family ties creates mutual trust and understanding with special emphasis on inter-generational continuation (Kokkinaki & Vitalaki, 2013a, 2013b).

Design and Method

Subjects

Participants included grandparents with their infant grandchildren involved in a longitudinal and naturalistic study. The aim of this study was to investigate basic aspects of spontaneous imitation in early dyadic grandfather- and grandmother-infant grandchild interaction (Pratikaki, 2009). Following the study's approval by the Faculty of Philosophical and Social Studies, University of Crete (Reference number 5/19-12-01), sixteen infant-grandmother and sixteen infant-grandfather pairs from Heraklion (northern Crete, Greece) of middle-class families took part in

the study (N = 48) [for details on subject recruitment and inclusion criteria see [Pratikaki \(2009\)](#)]. In 13 cases, maternal grandparents lived within the same building as the family. In the remaining three cases grandparents lived in close proximity (< 1km distance). In all families, both grandparents had a minimum contact of three hours three times a week with their grandchild.

At the beginning of the study, the grandfathers' mean age was 64.1 years (range 51-82 years) and the grandmothers' mean age was 56.8 years (range 50-67 years). Thirty five percent of grandfathers had a higher academic education, an equal percentage had twelve years of education, twenty percent had nine years of education and one grandfather had only completed primary school. Twenty five percent of grandmothers had a higher academic education, forty four percent had twelve years of education, nineteen percent had nine years of education and two grandmothers had primary school education. At the beginning of the study, of the 16 grandparent pairs, 9 grandfathers and 6 grandmothers were already retired. Seven grandfathers and five grandmothers were employed and five grandmothers were housewives.

Pregnancy, duration of labour, and perinatal factors were within normal limits. All the 16 infants [seven (7) girls and nine (9) boys] in the study were full term and healthy with normal mean birth weight and height according to the pediatricians' measurements. Ten infants out of the 16 were first-born, four were second-born and two were third-born (maternal grandmothers and grandfathers will be referred to from here on as "grandmothers" and "grandfathers").

Procedure

When both parents and grandparents gave their informed consent for the planned video-recordings, scheduled visits were arranged by the researcher according to the study protocol. The visits were arranged at a time suitable for the infants, this being half an hour following feeding time, when the infant was most likely to be relaxed and alert for interpersonal interaction ([Kugiumutzakis, 1993](#)), while the grandparents were taken into consideration as well.

Video-recordings were made at 15-day intervals, starting when the infant was 2 months old until he/she was 10 months old. Each recording lasted 7 minutes, while a short pause of five minutes was allowed before the second grandparent interacted with the infant. In the course of the first visit, half of the infants interacted with the grandfather and half with the grandmother. In the course of the second visit, the sequence of video-recordings with the grandparents was counterbalanced, switching the order in each successive visit. The only instruction given to the grandfathers and the grandmothers was: "Please play as you normally do with your grandchild." [see [Pratikaki \(2009\)](#) for details on the recording conditions]. According to the design of the present study, the data collection consisted of 17 visits for each of 16 infant-grandfather and infant-grandmother dyads (one visit at a 15-day interval from the 2nd to the 10th month of the infants' life), that is, 544 seven-minute recordings (16 families x 17 visits = 272 visits x 2 grandparents = 544 recordings). By the end of the study, we had made 262 visits and 524 recordings (4% data loss, due to grandparents' and infants' indisposition) [see [Pratikaki \(2009\)](#) for details related to data loss].

Coding

Within each sample of infant-grandparent interaction, given that an imitation had occurred, units of interaction were defined and the emotional context was analyzed within each imitative episode. Each unit of interaction was characterized by a temporal continuity and consisted of the period that preceded, accompanied and followed each

imitative episode. The temporal and qualitative description of the unit of interaction depended on the type of communication before and after the imitative episode. In other words, the type of communication was categorized in one of the following two mutually exclusive and exhaustive types: (a) communicative (“protoconversational”) in which the infant and the grandparent interact in a mutually attentive manner, coordinated emotional states, eye contact, oral expressions and body movements, either in alternation or overlapping; (b) non-communicative which consisted of periods in which the infant did not join the interaction because he/she was directing interest to the environment or was fully absorbed by his/her psychological mood (Kokkinaki, 1998, 2003). Within a temporal period of 10 seconds, before the beginning and after the end of each imitative episode, the categorization of the type of communication was made according to 50% of this temporal period. In other words, if the quality of interaction was “protoconversational” for at least 5 seconds before the beginning of the imitative episode, then the type of interaction was categorized as communicative. Within each unit of interaction, an imitative episode 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. Imitation was identified when one individual’s expression (vocal, kinetic, facial or any combination of these), of a form that had not been expressed by either partner in the immediately preceding 10 seconds, is reproduced by his or her partner within a 10-second interval. The response period of 10 seconds has been deemed to be adequate for imitation tests with infants (Heimann & Ullstadius, 1999; Kokkinaki & Kugiumutzikis, 2000). Within each unit of interaction, both infants’ and grandparents’ emotional expressions before, during and after the imitative episodes were coded. Coding of the emotional states was continuous, the onset time of any change in emotion also being the offset time of the previous emotion. Continuous coding of a pair of subjects yielded two separate records of emotional expressions and their shifts, one for each communicative partner, throughout the unit of interaction. The coding of the emotional expressions was based on observation and microanalysis (at the level of the second) of five types of facial expressions: pleasure, interest, pleasure-interest, neutral and negative.

The pleasure facial expression was coded when the eyes are open, focused and attentive to the partner and the mouth is elongated – closed, slightly open or open in the horizontal plane. The corners of the mouth are slightly pulled back and/or drawn upwards. The lips are slightly or more distinctly stretched causing wrinkles on each side of the mouth and the cheeks are slightly drawn upwards or raised (Darwin, 1872/1965; Field, Woodson, Greenberg & Cohen, 1982; Gerwitz, 1967, as cited in Dunkeld, 1978).

The interest facial expression was defined according to eye contact, gaze or orientation to the other partner’s face or body. When one partner is gazing at the other partner’s face or body, interest was signaled by an unsmiling face, with open eyes. The lips are usually open or at other times loosely closed. When the lips are open, the corners of the mouth are slightly downward, with the upper lip in a reversed-U shape, and the lower lip is relaxed or slightly stretched. The infant’s fixed gaze on the partner’s eyes is often accompanied by a shift of gaze from eyes upwards to the hair, down to the mouth (Darwin, 1872/1965; Dirks & Gibson, 1977, as cited in Exline, 1982; Eibl-Eibesfeldt, 1989; Tomkins, 1980; Trevarthen 1977, 1979). In addition to gaze behavior, one or a combination of the following facial, vocal or body expressions may occur: (a) Raised eyebrows; (b) Knitted eyebrows; (c) Blinking; (d) Cooing (for the infant) or other vocalizations (infant, grandparent); (e) Pre-speech mouth movements (infant); (f) Sequences of intense limb movements followed or preceded by motionless and stretched hand and leg postures (infant), or change of body posture that signifies alertness (grandparent) .

The pleasure-interest expression was coded when combinations of expressions of pleasure (1) and interest expressions (2) were evident. For example: (1) facial expression of pleasure was evident at the same time as one

or a combination of the following interest expressions: (2a) Momentary intense limb movements or sequences of intense limb movements followed or preceded by motionless and stretched hand and leg postures (infant) or change of body posture which indicates alertness [e.g. grandfather is sitting on a chair, or is leaning to the infant, and then he is standing upright, see [Figure 1.1](#) to [1.6](#)]; (2b) The infant is looking intently at the partner with wide open eyes and raised eyebrows; (2c) Coing and/or pre-speech mouth movements ([Markodimitraki, 2003](#); [Pratikaki, 2009](#)).



Figure 1.1. Hand movement imitative episode in grandfather-infant grandchild (girl-7.5 months old) interaction: In the course of eye contact, the grandfather is looking at his infant grandchild with a pleasure-interest expression (smile with raised eye brows) while he is leaning towards her and the infant is grinning to him.



Figure 1.2. The infant grandchild is raising her right hand while she is looking intently at her grandfather who is still leaning towards her and is focused on her with a facial expression of pleasure.

The definition of pleasure-interest expression was based on the following evidence: a) Gaze plays a fundamental role in the processing of facial expressions from birth and, at the same time, facial expressions are essential in the encoding of gaze direction ([Rigato & Farroni, 2013](#)); b) Oster (1978, as cited in [Trevarthen, 1985](#)) observed that as the infant orients to a speaking mother's face in the second month, there is a cycle between an intensely focused "knit brow" expression while the infant fixes the mother's eyes, *and* a smile in which the brows relax; c) Eye-contact becomes more sustained at 4 to 6 weeks after a full term birth, *at the same time* as smiles become



Figure 1.3. The infant grandchild is raising her right hand higher and stretching her fingers while smiling and looking at her grandfather. The grandfather is making a preparatory head movement in order to imitate her with a pleasure-interest expression.



Figure 1.4. The grandfather is orienting his torso, head and right hand, and is changing his body posture to an upright position, in order to imitate his infant grandchild's hand movement while he is still smiling. The infant is keeping her right hand up while she is focused on him.

stronger and more regular (Wolff, 1959, 1963, 1969, as cited in Trevarthen, 1985); d) From about 6 weeks infants show positive affective expression *linked to* maintained eye contact (Trevarthen 1977, as cited in Trevarthen, 1985); d) “A bright and sparkling eye is as characteristic of a pleased or amused state of mind, as is the retraction of the corners of the mouth...” (Darwin, 1872/1965, p. 204).

A neutral expression was identified when a partner had an indifferent expression in relation to the other partner's solicitations to engage in interaction. In other words, one partner was not looking or orienting him/herself to the other partner's face or body and his/her expression was that of an unsmiling, relaxed face, with no signs of body movements or vocalization or intent to vocalize (such as pre-speech mouth movements). In another situation, neutral was coded when the infant showed signs of self-absorption (looking passively at their own body/parts of the body) or sleepiness (yawning, rubbing eyes). Looking away from the partner has been correlated with a



Figure 1.5. The grandfather is imitating his infant grandchild's hand movement (see Note 1) while he is smiling and has now changed his body posture from leaning to his infant grandchild to standing upright. The infant grandchild is still keeping her right hand up and she is looking intensely at her grandfather.



Figure 1.6. At the end of the imitative episode, in the course of mutual eye contact, the grandfather is expressing a relaxed "pleasure" emotional state.

neutral expression, relaxed brows and closed mouth (Murray & Trevarthen, 1985). With the neutralization of emotion the "...facial muscles may be relaxed, or they may be held tensely but without any obvious sign of contraction..." (Ekman & Friesen, 1975, as cited in Saarni, 1982, p. 137). Neutralization of emotion has been defined as a voluntary attempt to maintain little or no display of emotion (Ekman & Friesen, 1969, as cited in Masters & Carlson, 1984).

An infant's negative facial expression was signified by a furrowed brow (lines on the forehead), wrinkles around the eyes and the nose, tight and somewhat protruded lips. The mouth is either open or closed, the corners of the mouth are slightly downward or pulled downward, while the infant is gazing at or away from the parent's face or

trunk (Field et al., 1982). The denotation of *grandparents' emotional states as "negative"* was extremely rare and it was signified by signs of disappointment expressed by verbalization rather than by facial expression.

Intra- and inter-observer reliability measurements were made in reference to the quality and duration of all emotional categories (Pratikaki, 2009). To check intra-observer reliability, the first researcher (Anastasia Pratikaki) analyzed 100% of the recorded data and she re-scored a random sample of 33% of the material after an interval of 2 months following the first coding session and the agreement was assessed using Cohen's Kappa. Intra-observer reliability scores ranged from 0.82 to 0.89. The mean value of k for all categories was 0.84.

Given that Fleiss (1981) characterizes Kappa over 0.75 as excellent, inter-observer reliability was checked in order to overcome the primary researcher's familiarity with the coding scheme and the hypotheses of this study. Towards this aim, an undergraduate student of the Faculty of Philosophical and Social Studies was trained in the microanalysis of data and she scored a random sample of 33% of the material. Inter-observer reliability between the researcher's first analysis and the student's analysis ranged from 0.79 to 0.86. The mean value of k for all categories was 0.82.

An "agreement" was counted when the same facial expression of emotion was recorded at times that either overlap, or when both scores were within one of the same three short temporal intervals (1 = 0-0.5 seconds, 2 = 0.51-1.0 second, and 3 = over 1.0 second). A "disagreement" was counted when: (a) One observer recorded one facial expression of emotion and the other didn't (e.g. one observer scored a pleasure facial expression of emotion and the other didn't); (b) One observer scored a facial expression of emotion of one valence (e.g. pleasure facial expression which is of positive valence) and the other recorded another facial expression of emotion of the same valence (e.g. pleasure-interest), or another emotional expression of a different valence (e.g. negative); (c) Both observers scored the same quality of different durations of emotional expressions, if scores were within different temporal intervals.

The difficulty of establishing high inter-observer reliability, when a complicated coding system is used, should be noted. The increased task demands on the rater and the multiple messages of a complex interaction are recognized as two factors that contribute to the difficulty of establishing high inter-observer reliability (Bakeman & Gottman, 1986). Given these constraints, we consider the inter-observer reliability scores given above to be satisfactory.

Statistical Analysis

- Hypothesis 1 will be tested through the descriptive analysis of grandparents' and infants' pleasure, interest, pleasure-interest, neutral and negative expressions before, during and after imitation.
- Hypothesis 2 will be tested through the chi-square analysis between infants' and grandparents' (grandmothers' and grandfathers') emotional expressions before, during and after imitation.
- Hypothesis 3 will be tested through the longitudinal analysis of the (grandparent gender*infant age) interaction effect [(infant age) and (grandparents' gender) main effects] on emotional expressions along the age range of this study. For the needs of the longitudinal analysis, infant age-range of 2 to 10 months was grouped into three successive age levels: (a) 2 to 3.5 months; (b) 4 to 7.5 months; (c) 8 to 10 months. The selected age levels represent periods of infant development with common social, emotional and motivational features (Trevarthen, 2005) corresponding to early, mid and late infancy.

Chi-square tests were used to determine possible relationships between pairs of variables. Longitudinal analysis output was carried out by using Wilk's Lambda test and a p -value $< .05$ as the level of statistical significance. Within-subjects factors were grandparent gender [two levels (grandfathers and grandmothers)] and infant age [three levels (2-3.5 months, 4-7.5 months and 8-10 months)]. Homogeneity controls of Repeated Measures was carried out using the Mauchly test and in cases of significant deviation (sphericity problem), assessment of significance was carried out with the appropriate correction of degrees of freedom and the use of the Greenhouse-Geisser Correction. All analyses were performed using the SPSS statistical package (Version 13, 2004).

Results

Descriptive Analysis of Grandparent and Infant Emotional Expressions Before, During and After Spontaneous Imitation

Before imitation, infants' interest expression, in both interactions with grandfathers and grandmothers (37% in each interaction) (Table 1, rows 2, 4), and grandfathers' and grandmothers' pleasure-interest expression (48% and 61%, respectively) (rows 1, 3) predominated over the remaining facial expressions of emotion. In the course of imitation, infants' pleasure-interest expressions, in both interactions with grandfathers and grandmothers (42% and 43%, respectively) (rows 6, 8), and grandfathers' and grandmothers' pleasure-interest expressions (65% and 73%, respectively) (rows 5, 7) prevailed over the other emotional expressions. After imitation, infants' interest expressions, in both interactions with grandfathers and grandmothers (34% and 31%, respectively) (rows 10, 12), and grandfathers' and grandmothers' pleasure-interest expressions (48% and 57%) (rows 9, 11) predominated over the remaining emotions. An overall descriptive view of Table 1 provides the following evidence: (a) Grandparents increased the pleasure-interest expression while single pleasure and interest decreased in the course of imitation. Grandparents' neutral expression remained stable, at low levels, before, during and after imitation. Grandfathers were more interested than grandmothers and grandmothers expressed more pleasure-interest towards their infant grandchildren, compared to grandfathers; (b) Similar patterns of infant grandchildren's emotional expressions in interactions with grandfathers and grandmothers provided evidence that infant interest predominated over the remaining expressions before imitation, it decreased in the course of it and it increased after it. Infants' pleasure remained stable before and in the course of imitation and decreased slightly after it. Infants' pleasure-interest expression increased in the course of imitation. Infants were less neutral in the course of imitation.

Relationship Between Infant / Grandparent Emotional Expressions and Grandparent Gender

Infants' emotional expressions were not found to differ significantly in interactions with grandfathers and grandmothers either before ($\chi^2 = 2.964$, $df = 4$, $p = .564$) (Table 1, rows 2 and 4), during ($\chi^2 = 5.009$, $df = 4$, $p = .286$) (rows 6 and 8), or after imitation ($\chi^2 = 1.780$, $df = 4$, $p = .776$) (rows 10 and 12). Grandfathers' and grandmothers' emotional expressions were found to differ significantly before ($\chi^2 = 25.302$, $df = 4$, $p = .001$) (rows 1 and 3), during ($\chi^2 = 17.343$, $df = 3$, $p = .001$) (rows 5 and 7), and after imitation ($\chi^2 = 14.399$, $df = 4$, $p = .006$) (rows 9 and 11), due to higher frequency of grandmothers' pleasure-interest and grandfathers' interest expression, compared to grandfathers and grandmothers, respectively.

Longitudinal Analysis of Grandparent and Infant Emotional Expressions

Longitudinal analysis provided the following evidence (Table 2): (a) Before imitation: infants' pleasure-interest expressions decreased at the age of 8 to 10 months and, across the age range, grandfathers' interest expression predominated over grandmothers' interest expression; (b) In the course of imitation: infants' pleasure correlated significantly with infant age, even after the appropriate correction of degrees of freedom (Greenhouse-Geisser

Table 1

Frequencies (Percentages) of Infant, Grandfather (GF) and Grandmother (GM) Emotional Expressions Before, During and After Imitation

	Pleasure	Interest	Pleasure-Interest	Neutral	Negative	Total
Emotional Expressions Before Imitation						
<i>Grandfather-Infant Interaction</i>						
1. GF	78 (11%)	264 (38%)	339 (48%)	21 (3.0%)	1 (0.1%)	703 (100%)
2. Infant	126 (18%)	263 (37%)	107 (15%)	191 (27%)	16 (2.0%)	703 (100%)
<i>Grandmother-Infant Interaction</i>						
3. GM	64 (10%)	170 (26%)	396 (61%)	17 (3.0%)	-	647 (100%)
4. Infant	129 (20%)	236 (37%)	105 (16%)	157 (24%)	20 (3.0%)	647 (100%)
Emotional Expressions in the Course of Imitation						
<i>Grandfather-Infant Interaction</i>						
5. GF	50 (7%)	183 (26%)	455 (65%)	15 (2.0%)	-	703 (100%)
6. Infant	129 (18%)	154 (22%)	297 (42%)	103 (15%)	20 (3.0%)	703 (100%)
<i>Grandmother-Infant Interaction</i>						
7. GM	54 (8%)	111 (17%)	473 (73%)	9 (1.0%)	-	647 (100%)
8. Infant	136 (21%)	140 (22%)	279 (43%)	71 (11%)	21 (3.0%)	647 (100%)
Emotional Expressions After Imitation						
<i>Grandfather-Infant Interaction</i>						
9. GF	87 (12%)	249 (35%)	336 (48%)	31 (4.0%)	-	703 (100%)
10. Infant	113 (16%)	238 (34%)	143 (20%)	188 (27%)	21 (3.0%)	703 (100%)
<i>Grandmother-Infant Interaction</i>						
11. GM	65 (10%)	199 (31%)	367 (57%)	15 (2.0%)	1 (0.1%)	647 (100%)
12. Infant	108 (17%)	202 (31%)	127 (20%)	187 (29%)	23 (4.0%)	647 (100%)

Correction, $df = 1.391$, $F = 7.681$, $p = .007$). This correlation was due to a significant increase in infants' pleasure at the second age level (4-7.5 months) (see Figure 2).

Table 2

Summary Table of Longitudinal Analysis (Wilk's Lambda) of Grandparent (GP) and Infant Emotional Expressions That Preceded, Accompanied and Followed Spontaneous Imitation in Dyadic Grandfather- and Grandmother-Infant Interaction

	Infant Age*GP Gender	Infant Age Effect	GP Gender Effect
	Λ -value, F, p-value	Λ -value, F, p-value	Λ -value, F, p-value
Emotional Expressions Before Imitation			
<i>Grandparent Emotional Expressions</i>			
Pleasure-Interest	.87, $F(2, 13) = 0.96$, .40	.72, $F(2, 13) = 2.42$, .12	.78, $F(1, 14) = 3.75$, .07
Interest	.94, $F(2, 13) = 0.34$, .71	.81, $F(2, 13) = 1.50$, .25	.71, $F(1, 14) = 5.71$, .03
<i>Infant Emotional Expressions</i>			
Pleasure-Interest	.87, $F(2, 13) = 0.91$, .42	.60, $F(2, 13) = 4.23$, .03	.98, $F(1, 14) = 0.22$, .64
Interest	.85, $F(2, 13) = 0.91$, .35	.84, $F(2, 13) = 1.15$, .34	.99, $F(1, 14) = 0.22$, .84
Emotional Expressions in the Course of Imitation			
<i>Grandparent Emotional Expressions</i>			
Pleasure-Interest	.84, $F(2, 13) = 1.16$, .34	.87, $F(2, 13) = 0.974$, .40	.85, $F(1, 14) = 2.32$, .15
Interest	.74, $F(2, 13) = 2.19$, .15	.99, $F(2, 13) = 0.009$, .99	.71, $F(1, 14) = 5.70$, .03
Pleasure	.83, $F(2, 13) = 1.24$, .31	.82, $F(2, 13) = 1.369$, .28	.91, $F(1, 14) = 1.33$, .26

	Infant Age*GP Gender Λ -value, F, p-value	Infant Age Effect Λ -value, F, p-value	GP Gender Effect Λ -value, F, p-value
<i>Infant Emotional Expressions</i>			
Pleasure-Interest	.94, F(2, 13) = 0.41, .66	.85, F(2, 13) = 1.079, .36	.90, F(1, 14) = 1.51, .23
Interest	.98, F(2, 13) = 0.11, .89	.71, F(2, 13) = 2.655, .10	.91, F(1, 14) = 1.33, .08
Pleasure	.69, F(2, 13) = 2.83, .09	.29, F(2, 13) = 15.626, p < .001	.87, F(1, 14) = 1.93, .18
Neutral	.95, F(2, 13) = 0.30, .74	.89, F(2, 13) = 0.79, .47	.7, F(1, 14) = 5.98, .028
Emotional Expressions After Imitation			
<i>Grandparent Emotional Expressions</i>			
Pleasure-Interest	.89, F(2, 13) = 0.76, .48	.37, F(2, 13) = 10.97, .002	.83, F(1, 14) = 2.70, .12
Interest	.97, F(2, 13) = 0.17, .83	.77, F(2, 13) = 1.90, .18	.69, F(1, 14) = 6.28, .02
Pleasure	.93, F(2, 13) = 0.46, .63	.70, F(2, 13) = 2.67, .10	.98, F(1, 14) = 0.21, .64
<i>Infant Emotional Expressions</i>			
Pleasure-Interest	.78, F(2, 13) = 1.76, .21	.57, F(2, 13) = 4.76, .02	.99, F(1, 14) = 0.08, .77
Interest	.95, F(2, 13) = 0.24, .78	.74, F(2, 13) = 2.18, .15	.95, F(1, 14) = 0.69, .41
Pleasure	.83, F(2, 13) = 1.24, .32	.57, F(2, 13) = 4.74, .02	.88, F(1, 14) = 1.82, .19

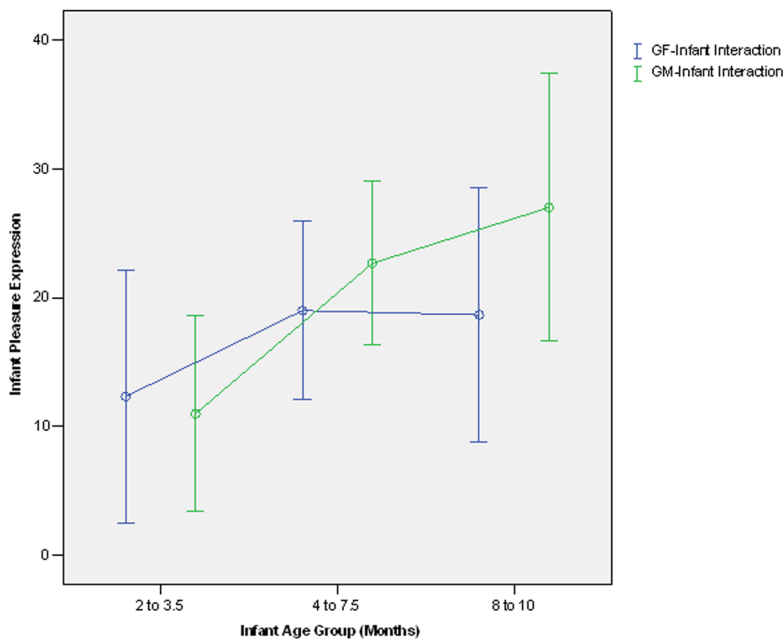


Figure 2. Developmental curves of infant pleasure expression (frequency) in dyadic grandfather and grandmother-infant grandchild interaction across the 2nd to the 10th month of an infant's life.

The significant (grandparent gender) correlations with (a) grandparent interest and (b) infant neutral expression were due to the evidence that: (1) Grandfathers were more interested in interaction with their infant grandchildren, compared to grandmothers, across the age range (see Figure 3); (2) Infants were more neutral in interactions with their grandfathers, compared to grandmothers, particularly at the first age level (2 to 3.5 months);

(c) After imitation: Infant and grandparent pleasure-interest expressions decreased at the age of 8 to 10 months though infant and grandparent pleasure increased across the age range of this study, even after the appropriate

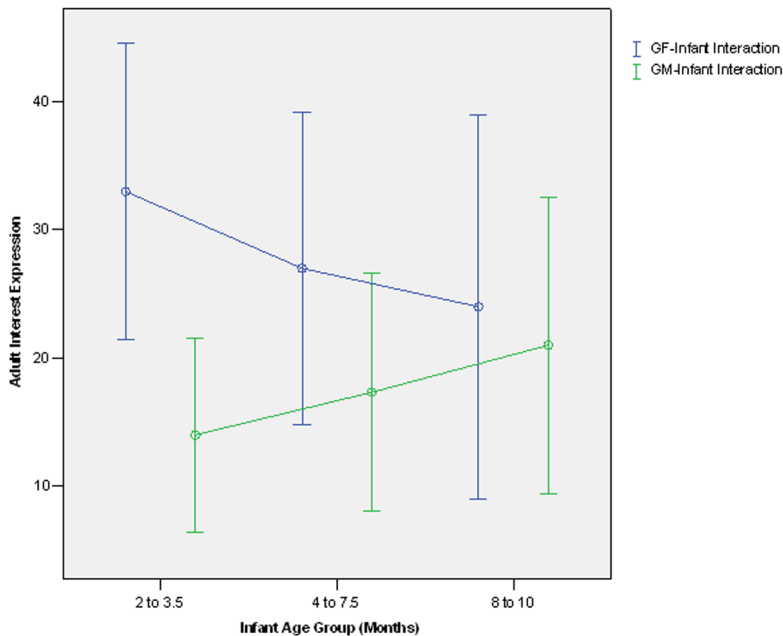


Figure 3. Developmental curves of adult (grandparent) interest expression (frequency) in dyadic grandfather and grandmother-infant grandchild interaction across the 2nd to the 10th month of an infant's life.

correction of degrees of freedom (Infant pleasure: Greenhouse-Geisser Correction, $df = 1.46$, $F = 5.19$, $p = 0.02$; Grandparent pleasure: Greenhouse-Geisser Correction, $df = 1.32$, $F = 4.79$, $p = 0.03$). Across the age range, grandfathers' interest expression predominated over grandmothers' interest expression.

Discussion

The aim of this study was to describe and compare grandparents' and infants' facial expressions of emotions that precede, accompany and follow spontaneous imitation in dyadic grandfather- and grandmother-infant grandchild imitation from the 2nd to the 10th month of an infant's life.

The results of this study can be summarized as follows: (a) Grandparents increased the pleasure-interest expression while single pleasure and interest decreased in the course of imitation. Grandparents' neutral expression remained stable, at low levels, before, during and after imitation. Grandfathers were more interested than grandmothers and grandmothers expressed more pleasure-interest towards their infant grandchildren, compared to grandfathers. (b) Similar patterns of infant grandchildren's emotional expressions in interactions with grandfathers and grandmothers provided evidence that infant interest predominated over the remaining expressions before imitation, it decreased in the course of it and it increased after it. Infants' pleasure remained stable before and in the course of imitation and decreased slightly after it. Infants' pleasure-interest expression increased while their neutral expression decreased in the course of imitation. Infants were more neutral in interactions with their grandfathers, compared to grandmothers, particularly at the first age level (2 to 3.5 months). (c) Infant age correlated with certain infants' and grandparents' emotional expressions. This evidence verified the first (for the most part), second and third hypothesis of this study.

Evidence of infants' pleasure stability before and during imitation did not verify part of the first hypothesis of this study and is not consistent with infants' pleasure increase found by [Markodimitraki \(2003\)](#). This inconsistency may be due to differences in the methodology (sample size, video-recording duration) and in the descriptive analysis. Furthermore, infant interest expression before imitation confirms the evidence of experimental and naturalistic studies that the infant may become attentive before he/she makes a matching expression ([Field et al., 1982](#); [Heimann, 1989](#); [Heimann & Schaller, 1985](#); [Kugiumutzakis, 1983, 1985](#); [Maratos, 1973](#); [Meltzoff & Moore, 1983](#)). After the model presentation, the pleasure expression of infants as young as 2 months old, is consistent with the first appearance of a smile in 2-day-old infants and at 15 days of age ([Kugiumutzakis, 1999](#)). The evidence that infants and grandparents find imitative exchanges interesting and pleasurable extends to the first generation and confirms Kugiumutzakis' proposition (1999; [Kugiumutzakis et al., 2005](#)) and [Kokkinaki's \(1998\)](#) findings that the prevailing emotions felt by the infant and parents before, during and after the intersubjective imitative game are those of interest and pleasure.

The predominance of grandparents' and infants' positive emotional expressions over neutral/negative ones before, during and after spontaneous imitation seems to reinforce the empirical evidence that both grandmothers and grandfathers are communicative partners in relation to infant grandchildren ([Kokkinaki & Vitalaki, 2013a, 2013b](#); [Kokkinaki et al., 2012](#); [Pratikaki et al., 2011](#); [Trevarthen, 1979](#)). In particular, it has been assumed that: (a) After the presentation of the model and before the first correct imitative response, the infant has to try to perceive the model clearly ([Kugiumutzakis, 1999](#)). This assumption integrates the infants' interest expression in the course of imitation (see definition of imitative episode in *Coding*), which indicates that an active readiness for sympathetic reciprocal involvement with another person is an essential component of the ability to imitate ([Trevarthen, 1997](#)). The expression of interest, both by infants and grandparents, *before and during imitation* reinforces the view that interest is present and functional on an inter-mental level before and on an intra-mental level during imitation ([Kugiumutzakis, 1999](#)). (b) The infant must also discriminate the self and the other as two separate persons coexisting in the same three-dimensional space, both involved within an interacting unit. *In the course of imitation*, in interactions between infants and grandmothers, infant pleasure, interest and pleasure-interest was expressed in 21%, 22% and 43% of all imitative episodes, respectively. Grandmothers were pleased, interested or pleased-interested in 8%, 17% and 73%, respectively. Similarly, in interactions between infants with their grandfathers, infants expressed pleasure, interest and pleasure-interest in 18%, 22% and 42%, respectively, of all imitative episodes. Grandfathers were pleased, interested or pleased-interested in 7%, 26% and 65%, respectively, of all imitative episodes ([Table 1](#)). Taking into account all the possible combinations between the infants' and the grandparents' emotional expressions, we may conclude (theoretically) that, in the course of imitation, when infants interact in dyads with their grandmothers and their grandfathers they either match their positive emotions (that is, both express pleasure, or interest, or pleasure-interest), or one completes the emotional expressions of the other (that is, one is expressing pleasure while the other is expressing interest, and vice versa, or one is expressing pleasure-interest while the other is expressing pleasure or interest). If this theoretical consideration is verified empirically, it would reinforce the evidence, and thus apply to grandfathers as well, that infants and grandmothers adjust the timing, form and energy of their expressions to obtain inter-synchrony ([Kokkinaki & Vitalaki, 2013a, 2013b](#)). (c) Infants' and grandparents' interest expressions *during and after* imitation are integrated in the assumption that the recognition of the modelled movement and sounds as incomplete may evoke the emotion of interest. Differences between the model and the reproduction, after the end of imitation, may constitute not errors but significant information in their cooperation ([Trevarthen et al., 1999](#)). This is consistent with the view that imitation is the result of activity of an investigative motive system that seeks another who will complete or satisfy it in dynamic

ways (Trevarthen, 1997). Grandparents' and infants' pleasure expressions verify the proposition that infant's imitation is treated by an affectionate partner to be a signal of recognition of the other (like a smile) as a partner for intersubjective games that evoke the pleasure of being together (Kugiumutzakis, 1999; Trevarthen, 1997). These assumptions need further exploration through the analysis of the relationship between infants' and grandparents' emotional expressions depending the direction of imitation¹ (who imitates whom).

This study provided evidence that grandmothers' pleasure-interest expression and grandfathers' interest preceded, accompanied and followed imitation (longitudinally for grandfathers' interest) more frequently than grandfathers' and grandmothers' respective expression. This evidence challenges the results that in rural and urban Greece, grandmothers were more caring than grandfathers (Pashos, 2000) and that in rural Gambia male kin, including maternal grandfathers, have a negligible impact on the child's nutritional status and survival (Sear et al., 2000; Sear & Mace, 2008). Furthermore, this evidence is not in accordance with the conventional profile of grandfathers according to which they have peripheral, distant or limited involvement with their grandchildren (Baranowski, 1991; Burly-Cunningham, 1984, as cited in Waldrop et al., 1999). At the same time, we provided evidence that infants were more neutral in interactions with their grandfathers, particularly at the first age level (2 to 3.5 months). It may be that grandmothers are more experienced, more composed and more familiar with the care giving needs of their infant grandchildren, thus better able to focus on and enjoy the "unfolding" of infant grandchildren's expressions in a more relaxed and confident way. In contrast, due to embarrassment and anxiety, grandfathers (Tinsley & Parke, 1987) initially trigger infants' neutral expression. Furthermore, two cultural elements of Crete, those being distrust towards outsiders (researcher) and the distinction between male and female roles (Legg & Roberts, 1997, as cited in Terkenli et al., 2007), may cause a camera shot effect (real-time recordings) in the first video-recordings of grandfathers interacting with their grandchildren in the Cretan society of Heraklion. Infants' neutral expression in these initial interactions with grandfathers may be counterbalanced longitudinally with the intense attention of grandfathers to infants' expressive behaviors and their (grandfathers') eager imitation of infants' expressions, with the intention of continuing interaction (Pratikaki et al., 2011). The mean duration of the components of imitation (model, pause, imitation and total duration) reinforces this interpretation since the pause duration before imitation is shorter in grandfather-infant interaction (0.87 secs), thus grandfathers wait less, when compared to grandmother-infant interaction (0.97 secs) (Pratikaki et al., 2011). This evidence needs to be further investigated according to infant gender because it may be that grandfathers, similarly to fathers, use more cognitively challenging expressions with boys than with girls and encourage them, more than they do girls, to control their emotions (Leaper, Anderson, & Sanders, 1998).

This study brought evidence for correlations of infant age with certain infant emotional expressions that preceded, accompanied and followed spontaneous imitation in grandparent-infant interaction. The changes in the developmental curves of infant pleasure, in the course of imitation, and pleasure-interest expression, that preceded and followed imitation, are integrated in the assumption that imitation has dynamic intersubjective regulatory functions from the beginning of human interactive life. However, the message it conveys changes as the infant motives undergo age-related developments. The increase in infant pleasure at the age of 4 to 7.5 months may reflect the development in range and vigour of attending and acting in the period of games (4 to 8 months) when "teasing" provocations multiply compared to earlier weeks (Trevarthen et al., 1999). The decrease in infants' pleasure-interest expression at the age of 8 to 10 months may be attributed to brain development, under-structured by the emotional quality of motive interchanges that occur at the end of the games period, around the eighth month, and signify Secondary Intersubjectivity. The decrease in pleasure-interest expression may be counterbalanced by the most striking feature of this communicative perspective which is the systematic combination of infants' interests in the

physical world and their communicative acts addressed to other persons (Trevarthen, 1993; Trevarthen & Hubley, 1978). In connection to this, the non-significant decrease in the frequency of infant imitations in the course of the 8th to 10th month (Kokkinaki et al., 2012) further reinforces the assumption that imitation constitutes the most “dramatic” connection between endogenous motives (that take a recognizable form as emotions) and intentionality (expressive behaviors) (Trevarthen, 1977, 1997).

Our conclusions are limited in a number of ways. These data describe the imitative exchanges in a restricted sample of Greek white middle-class infants and their grandparents who are in close proximity to their infant grandchildren and adult children. These data are based on a relatively short time period with respect to the total interaction time spent between grandparent and infant grandchildren. Obviously, generalization of these findings to a larger sample, observed for longer periods that would include interactions between grandparents and infants living at a distance and belonging to other socio-economic and cultural populations, is limited. Moreover, given that a theory of grandparenthood per se has not been advanced (Thomas et al., 2000), we interpreted our results based on a developmental perspective and we supported the inter-subjective nature of early imitation in the absence of statistical analysis of the relationship between infants’ and grandparents’ emotional expressions depending on the direction of imitation.

In sum, this study has provided evidence that grandparents’ and infants’ positive emotional expressions, before, during and after imitation, imply an active readiness for sympathetic reciprocal involvement, adjustment of the timing, the form and the energy of their expressions. Grandparents’ and infants’ emotional expressions that accompany spontaneous imitation provide evidence of an investigative motive system that seeks another who will complete or satisfy it in dynamic ways, and are a sign of recognition of the other as a partner for intersubjective games.

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Notes

1) The direction of imitation (who imitates whom) has been assumed to contribute to grandparent-infant communication. There is evidence that, from the 2nd to the 10th month of an infants’ life, grandmothers and grandfathers tend to imitate the grandchild’s behaviors (61%) more than vice versa (39%) (Pratikaki et al., 2011). It may be that infants compensate or counter balance for the predominance of grandparents over infant imitation by matching their emotional expressions to their partners’, more than vice versa. This is integrated in the assumption that human communication is regulated by an integrated system of equivalent expressions in which responses are complementary translations of the partners’ expressions (Trevarthen, 1993).

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