Sex-related differences in cooperation and communication with young infants

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Abstract

We compared 'emotional coordination' and 'non-matching' in spontaneous dyadic interactions of infant girls and boys with their mothers in early infancy. Eleven infant-mother dyads from Crete, Greece, six with girls, and five with boys, were observed during natural interactions at home from the second to the sixth month of life. Micro-analysis was used to investigate 'coordination' and 'non-matching' of facial expressions of emotion. 'Emotional coordination' was evaluated with four measures: *matching* of facial expressions, *completion* when one responded to the other with 'pleasure' or 'interest', *synchrony* by matching frequency of change or rhythm of emotional expressions, and *attunement* when shifts of emotional intensity of the two partners were in the same direction. '*Emotional non-matching*'was coded when neither the infant nor the mother showed interest in interacting with the other. In emotional coordination or non-matching between mother and infant, who performed first was also recorded. We obtained evidence of sex differences which are summarized as follows.

a) 'Emotional coordination' was stronger and more accurate with girls, while 'emotional non-matching' was stronger and more frequent with boys. The combination of 'emotional matching/completion' was more likely to occur with girls, while the combinations of 'emotional matching/non-matching' along with intermittent emotional non-matching were more likely to occur in interactions of infant boys with their mothers.

b) Infant girls responded with both 'emotional matching' and 'non-matching' of their mothers' emotional expressions more frequently than boys.

c) 'Emotional consistency' was stronger for *pleasure*, *interest* and *neutral* expressions of girls, while boys 'emotional consistency' was stronger for *external interest* and *negative emotion* compared to girls'. Mothers of boys showed more intense 'emotional consistency' than mothers of girls.

d) The developmental trajectories of 'emotional matching' and 'non-matching' follow different patterns in interactions of girls and boys with their mothers across the age range of this study.

In accord with the theory of innate intersubjectivity as an adaptation of human behaviours for social collaborations in action and experience, we assumed that girls and boys may differ in the way they

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adjust timing, form and energy of emotional expressions to obtain synchrony and 'subjective coherence' of their intentions and interests with their mothers. Such sex-related differences in communication may be understood to vitalize complementary roles in human communities that make both care of young minds and transmission of cultural knowledge and skills possible.

Keywords: mother-infant interaction, infant sex differences, facial expressions of emotion, emotional coordination, emotional matching, synchrony, completion, emotional non-matching, Innate Intersubjectivity.

Introduction

In a longitudinal and naturalistic study we compared 'emotional coordination' and 'non-matching' in spontaneous dyadic interactions of infant girls and boys with their mothers at home in early infancy. Consistent differences between the behaviours and experiences of boys and girls in early development are to be expected because sex-related variations in private self-discovery, cooperation and communication, made apparent in the ways human brains move the body at all ages, regulates relationships, animates human communities and sustains cooperation in a culture (Trevarthen, 1986a).

Sex differences of the brain, hormone concentrations and sensory processes related to emotional expressivity in foetuses, neonates and infants

Hormonally regulated sex-specific variations in the ultrastructure of the developing central nervous system change cell proliferation and distribution, altering cell numbers in specific brain structures. They support synaptogenesis, regulate cell death and patterns of cell migration and dendritic branching, and affect axonal guidance and neural connectivity. Such changes ultimately determine volumes of the amygdala and hippocampus - brain regions that are substrates for identification of the emotional significance of stimuli, and for the

generation of an affective response to the intensity of physiological arousal induced by positive or negative stimuli, emotion regulation and memory (Trevarthen, 1996; van Wingen et al., 2008; Alexander and Wilcox, 2012; Moore, 2012; Sakaki and Mather, 2012). The prenatal circulation of androgens produced by the male sex organs may act to suppress responsiveness of the perioral region of the newborn, and restrict facial expression of emotions (Korner, 1973).

Reports of hormone concentrations in human umbilical-cord blood indicate higher concentrations for *testosterone* in cord blood of males (Forest, Cathiard and Bertrand, 1974; Forest et al., 1974, cited by Maccoby et al., 1979), and Laatikainen found higher concentrations of progesterone produced by the adrenal glands in boys (Laatikainen and Peltonen, 1974, cited by Maccoby et al., 1979). In contrast, Forest and Cathiard (1978, cited by Maccoby et al., 1979) reported that levels of 17-α-*hydroxyprogesterone* (a derivative of progesterone also produced by the adrenal organs) are higher in the cord blood of female infants.

Fetal testosterone might mediate in activation of human social behavior and also have down-regulatory effects on cognitive sensitivity for emotions (van Honk et al., 2011). In normal development, levels of fetal testosterone inversely correlate with behaviors such as eye contact and social functioning (Baron-Cohen, Knickmeyer and Belmonte, 2005). Enhanced testosterone levels have also been correlated with reduced orbitofrontal cortex responses, which may reflect testosterone-induced changes in amygdala regulation (van Wingen et al., 2009). Given that amygdala is a structure with a high density of receptors for sex hormones, it appears plausible that increased androgen levels during the first few months of life in male infants may delay development of the amygdala and associated temporal cortical regions implicated in responses to face expressions (McClure, 2000). With regard to

responses to positive emotion, *progesterone levels* have been correlated with activations in the fusiform gyrus, a brain region involved in the recognition of emotion in faces (Champagne et al., 2012). Higher progesterone levels have been associated with an increase of amygdala activation (van Wingen et al., 2008; Sakaki and Mather, 2012), and, conversely, failure to identify negative emotions, has been associated with lower levels of progesterone and estrogen (Guapo et al., 2009).

Available evidence of sexual dimorphism in neonatal brains indicates that male newborns have about 9% larger intracranial volumes than females (Gilmore et al., 2007). Three-dimensional morphometry suggests that the corpus callosum, the commissure that interconnects the left and right hemispheres, is smaller in men relative to the total cerebral volume (Baron-Cohen et al., 2005). Increased interhemispheric communication via the corpus callosum in females is consistent with the finding that female adults when looking at faces scan for both local and configural information, showing interest in emotional expressions of eyes, mouth and brows as well as the whole face, whereas males switch from one processing to the other, attentive to identify the individual rather than their feelings (Rennels and Cummings, 2013).

Lower Apgar scores, of complexion, heart-beat, breathing, irritability and activity, for full term, healthy male compared to female newborns (Nagy, Orvos, Bakki and Pal, 2009) may reflect sex-related variations in the level of catecholamines in the umbilical artery. Alternations in the pathways mediating catecholamine transmission can impair the prefrontal cortex, which is essential for the top-down regulation of attention, behaviour and emotion, while mediations that optimize catecholamine actions can improve prefrontal cortex regulation of the same mental states (Arnsten and Pliszka, 2011).

Various sex differences have been reported in vision and gaze behavior of infants. At 2 and 3 months some tests of *visual sensing* favor boys (Dodkins, Bosworth and McCleery, 2009). This is consistent with the evidence of Rennels and Cummings (2013) that at 3-4 month female infants scan faces by shifting of attention between internal features of faces – eyes, eyebrows, nose and mouth -- which aids discrimination of emotional expressions. Males make more shifts between internal and external features (hairline, jaw and ears), which favours face recognition and identification of the person. In the course of the first 4-6 months of life, infant girls develop earlier than boys in *visual acuity*, *stereopsis* (with better control of *vergence* of the eyes), and in *evoked responses to changes in visual patterns* (Birch, Gwiazda and Held, 1982; Held, Shimojo and Gwiazda, 1984; Makrides, Neumann and Gibson, 2001; Malcolm, McCulloch and Shepherd, 2002, cited by Alexander and Wilcox, 2012). This earlier development of the use of sight is consistent with the readiness of infant girls compared to boys to engage in eye contact with an expression of interest in the first semester of life (Malatesta and Haviland, 1982; Lavelli and Fogel, 2002; Leeb and Rejskind, 2004). Later, at 3 and 6 months, girls gazed away more often than boys (Toda and Fogel, 1993) which confirms an earlier transition in females to interest in nearby surroundings. In short, while boys and girls show the same developments in visual curiosity and acuity in the first semester, the girls make the changes earlier.

Sex differences of attention and emotion in neonates, infants and mothers

The evidence on sex-related differences of engagement with expressive behaviors in the *neonatal period* seem to favor girls to boys in measures related to the duration and the latency of *attentiveness and face preference* (Hittelman and Dickes, 1979; Connellan et al., 2000; Nagy, Kompagne, Orvos and Pal, 2007), though Leeb and Rejskind, (2004) found no sex

differences in neonatal eye contact. Findings for neonatal *negative emotional expressivity*, *contagious crying (a precursor to empathic reactions), emotional non-stability and arousal regulation,* are inconsistent. Some findings favour boys (Brazelton, Koslowski and Main, 1974; Moss, 1974; Call, 1978; Feldman, Brody and Miller, 1980; cited by Nagy, Kompagne, Orvos and Pal, 2007). Others report stronger expression of these states in girls (Osofsky and O'Connell, 1977, cited by Weinberg, Tronick, Cohn and Olson, 1999; Velandia, Uvnäs-Moberg and Nissen, 2012). Male neonates show a more rapid build up of arousal and a quicker attainment of a peak of excitement (Osofsky and O'Connell, 1977, cited by Weinberg et al., 1999).

Regarding *affective processing*, infant girls were faster in their emotional response to social stimuli and displayed a longer duration of emotional expression than males (Losonczy-Marshall, 2008). This indicates that girls process facial information about feelings faster, and are more attentive to others than boys (McGlure, 2000). Evidence on sex-related differences in *smile frequency* is contradictory, favouring boys (Lasky and Klein, 1979; Roe and Beckwith, 1992), or girls (Cossette, Pomerleau, Malcuit and Kaczorowski, 1996), who are also reported to react more negatively than boys with expressions of anger at 2 ½ , 3-4, 5 and 7 ½ months (Malatesta et al., 1986; Mayes and Carter, 1990).

There are other inconsistencies in the literature, several authors reporting no sex-related differences in the *emotional/facial expressions and gazing behavior* of infants during face-to-face interaction with their mother in the first semester of life (Field, Vega-Lahr, Goldstein and Scafidi, 1987; Fogel, Tota and Kawai, 1988; Gusella, Muir and Tronick, 1988; Ellsworth, Muir and Hains, 1993; Toda and Fogel, 1993; Cossette et al, 1996).

It has been reported that mothers are more likely to engage in face-face interaction with girls, and that they talk to, smile and respond quicker to their infant daughters' facial

expressions than to those of their sons (Thoman, Leiderman and Olson, 1972; Moss, 1967, Goldberg and Lewis, 1969, Lewis, 1972, Parke and Sawin, 1980, Parke, 1981, cited by Weinberg et al., 1999). Such findings may be interpreted to favour the view that differences in the infants' behaviours are a consequence of the way their mothers seek communication with their sons and daughters, but it is likely that differences in the feelings and behaviours of the infants are also a key factor.

Sex differences in mother-infant emotional coordination and synchrony

At 3 and 6 months, Malatesta and Haviland (1982) found that mothers modelled similar frequencies and expressed both more matching of facial expressions and a greater inhibition of non-matching responses in communication with male infants, compared to their behaviours with females. Mothers were found to follow more female expressions with dissimilar, non-matching, responses. At 3, 6 and 9 months, Tronick and Cohn (1989) found that mother-son dyads spend more time in coordinated states than mothers-daughter pairs and had higher synchrony scores than mother-daughter dyads at 6 and 9 months. In agreement to this, Weinberg and colleagues (1999) found mother-son dyads at 6 months had higher synchrony scores than mother-daughter dyads, though male infants had greater difficulty than female infants in maintaining affective regulation and it took them longer to repair interactive errors.. This is inconsistent with evidence that synchrony between same-gender parent-infant dyads at 5 months has stronger lagged associations between parent and infant affect, more frequent mutual synchrony and shorter lags to responsiveness when compared with dyads of different gender (Feldman, 2003).

It is important that variations in the theoretical background and the methodology of the above studies (design, coding systems, segmentation procedure, precision of measurement,

sample size) confuse comparisons and make difficult the integration of the findings. In addition, neither behavioral matching nor synchrony measures determine who is responsible for the degree of coordination observed, and the limited number of naturalistic studies usually have not differentiated systematically the direction of influence (Beebe et al., 1985).

The aims of this study

With the intention to extend knowledge of the sex-related variations in the temporal organization of dyadic emotional engagement in early infancy, and to clarify the processes that regulate the direction of emotional exchanges, we investigated in detail the 'emotional coordination' and 'non-matching' taking place in spontaneous dyadic interactions of infant girls and infant boys with their mothers at home.

Emotional coordination was evaluated with four measures: a) *matching* if one partner expressed the same type of facial expression of emotion as the other; b) *completion*, when one partner expressed a positive valence of facial expression of emotion, 'pleasure' or 'interest', in immediate response to the other; c) *synchrony of emotional shifts* when one partner matched the frequency of change of emotional expressions of the other, disregarding the type of facial expressions; s*ynchrony of emotional expressions* when one matched the frequency of facial expressions of emotions of the same type of the other; and d) *attunement,* if one followed the shifts in the direction of emotional intensity of the other.

'Emotional non-matching' was coded when neither the infant nor the mother showed interest in interacting with the other. In 'emotional coordination' or 'non-matching' between mother and infant, who performed first was also recorded. The emotional expressions of mother or infant were judged as 'consistent' when they were the same throughout a subunit of 'dialogue'.

We aimed to advance methodology and gain new information in three ways. First, it is probable that the infant's sensitivities and their timing are richer in the *familiar environment at home* where communication will have different motivation as compared to that in the laboratory with fixed arrangements for recording or testing reactions in staged performances (Beebe et al., 1985). Secondly, interpretation of findings of this study depend on *continuous micro-analysis* – accurate to 1/25th of a second - of facial expressions of 6 infant girl-mother pairs and 5 infant boy-mother pairs, each of which was video-recorded for 8-10 minute spontaneous naturalistic interactions *from the 2nd to the 6th month of infant's life*, *at 15-day intervals*. Microanalysis in such detail is a time-consuming enterprise which "....yields a dense and rich population of events for each case study..." (Beebe, 1982, p. 174). Thirdly, we made a study with the same infants at 2 week intervals through all the ages of the chosen range, 2 to 6 months. Longitudinal studies are needed that obtain data at a sufficient frequency to track age-related changes (Trevarthen and Aitken, 2003; Trevarthen and Daniel, 2005).

According to the theory of innate intersubjectivity (Trevarthen, 1998, and in this volume; Trevarthen and Reddy, 2016, in press), engagements with infants reveal coordination within, and between, subjects in three essential features of the universal alphabet of "intersubjective motor control": *kinematics (timing of expressive behaviors)*; *energetics* (intensity that conveys information about the effort and vitality of motivation for movement); and *physiognomics* (transformations of organs of expression in distinct categories or shapes of movement). The same dimensions of 'vitality dynamics' have been richly defined in the work of Daniel Stern (1985, 2010, see Papastathopoulos, this volume). Previously, the 'microkinesics' of Ray Birdwhistell described the ways human communicators coordinate and compose expressive movements by self-synchrony using many parts of their own body,

and how they establish precise inter-synchrony with other persons' movements (Birdwhistell, 1970; Trevarthen, 2016).

In recognition of these principles of motor coordination in communication, this study aims to provide empirical evidence regarding sex-related differences/similarities in emotional non-matching, or in synchrony which does not occur by reflex or automatically, but purposefully as, "… by mutual regulation infant and mother appear to achieve a more complex co-operation..." (Trevarthen, 1977, p. 241). This is important if we accept that private thinking (what we are calling 'emotional non-matching' in this study) and social communication ('emotional coordination') exist as complementary processes from the start of mental life, changing with the same rhythms and cycles (Trevarthen, 1997). Compositions of actions that perform *narration,* the displaying of serially ordered episodes of felt experience in movement, permit transfer and imitation of internal motives by which each partner in a dialogue is regulating the dynamics of their consciousness and purpose (Lashley, 1951, cited by Trevarthen, 2015; Trevarthen, 1993a, 1993b).

Sensitivity for regulation of both subjective and intersubjective impulses and feelings undergoes age-related changes attributable to developments in the body and in the motivating processes of the brain that are adapted for cultural learning (Trevarthen and Aitken, 2003)**.**

Studying early spontaneous emotional coordination and non-matching in same-sex (mother-girl) and other-sex (mother-boy) dyads may extend our understanding of the origins and the function of sex-related differences and similarities in emotional expressivity, as they unfold in early intimate companionships of maternal care. On one hand, the other-sex dyads are favoured in that mothers appear to provide more scaffolding for boys by modelling expressions intensely and responding in a highly contingent manner to their emotional expressions. Their daughters, in contrast, may need less intense cues and less contingent

maternal modelling, perhaps as a function of the females' lower levels of expressivity than their male peers, or, perhaps, as a consequence of cultural gender stereotypes (McClure, 2000). On the other hand, the establishment of co-regulation may be easier for same-sex pairs because it may capitalize on the partners' similar inborn modes of arousal regulation (Feldman, 2003). The resolution of this issue is *complicated* by the following contradictory findings. If testosterone constitutes the trigger substance for differences in brain mechanisms of communication and thought in males and females, its effects on brain development are prolonged and elaborate (Trevarthen, 1986a). On the other hand, sex differences in sensory processes in infancy have been found to be transient and to have no long-term consequences for behaviour (Alexander and Wilcox, 2012). Further understanding of these matters is important because the complex balance of sex-related variations in private self-discovery, cooperation and communication, mediated by proven sex differences in brains, serves to vitalize human relationships and communities and supports cultural cooperation (Trevarthen, 1986a).

For the present study we begin with the following speculations based in information to hand.

Hypothesis 1:

(a) There will be quantitative differences between the interactions of infant girls and infant boys with their mothers in *emotional coordination* (matching, completion, synchrony and attunement).

(b) The emotional coordination will be both *stronger* and more *accurate* in interactions with girls compared to interactions with boys, and *emotional non-matching* will be stronger and more frequent with boys. Moreover, there will be differences in the transitions of

interpersonal engagement categories in mothers' interactions with infant girls and those with and boys.

Hypothesis 2:

Girls will initiate emotional matching and non-matching to their mothers' emotions more frequently than boys.

Hypothesis 3:

There will be differences in *emotional consistency.* Within-infant and within-mother emotional expressions will be more consistent in the engagements with infant girls compared to those with infant boys.

Hypothesis 4:

We also anticipate there will be differences between girls and boys in the effect of their age on the development of emotional matching, completion, and non-matching in interactions with mothers.

Method

Participants

Six infant girls and five infant boys participated in this study of communication with their mothers (Note 1). All infants were healthy and born without complications, they came from families in which at least one parent was employed and the mothers were older than 20 years of age. No infants who were at risk of medical disorder, with birth weight less than 1,700 gr, or with gestational age less than 34 weeks were selected. Table 1 shows the demographic information for the two groups.

Table 1: Demographic Information for the Sample

	Infant Girl –Mother Interactions			**Infant Boy-Mother Interactions**		
	Mean	SD	Range	Mean	SD	Range
Mother Age (years)	28.16	4.91	21-36	30.80	5.54	24-39
Mother Education (years)	13.66	2.65	16-18	15.32	1.78	16-18
Father Age (years)	32	3.89	27-37	35.60	7.30	28-47
Father Education (years)	13.83	2.85	16-18	15.20	1.78	16-18
Birth Weight (kg)	3450	583.09	2800-4150	3710	350.71	3300-4250
Birth Height (cm)	52	2.75	48-55	52.50	1.41	51-54
Breastfeeding (days)	57.55	67.7	0-180	28	52.1	0-120
Sex of Infants	6 girls (54.5%)			5 boys (45.5%)		
Birth Order	6 firstborns (54.5 %)			4 secondborns (36.4%) and 1 firstborn (9.1%)		
Way of Delivery	5 (45.4%) SVD*, 1 (9.1%) CS*			3 (27.3%) SVD, 2 (18.2%) CS		
Family Composition	two-parent families			two-parent families		
Socio-economic Status	middle-class families			middle-class families (Hollingshead, 1975)		

*SVD=Spontaneous Vaginal Delivery, CS=Caesarian Section

Procedure[5]

Video-recordings of spontaneous interactions between the infants and their mothers were made at 15-day intervals at their home, from the beginning of the Primary Intersubjectivity Period (2 to 4.5 months) until the end of the first Period of Games (4.5 to 6 months); that is, starting when each infant was 2 months old until she/he was 6 months old. These periods show developmental stages in the coordination of the infant self with familiar others in interactions, based on correspondences of timing, form and intensity of communicative behaviours (Trevarthen, 1984, 1993a, 1993b).

Each recording lasted 8 minutes for the 2 to 4-month-old infants and 10 minutes for the older infants aged 4.5 to 6 months. A total of 99 video-recordings were made for the entire sample and the total duration of video-recorded and analyzed interactions was 880 minutes: 480 minutes for girls and 400 minutes for boys. All recordings were made with a with a Panasonic NV-MS4 S-VHS HI-FI STEREO camera. The only instruction given to the mothers was: "Play as you normally do with your baby". The recordings took place in a room and a position chosen by the mother where there would be no interruption by a third-party.

Coding

Plan of micro-analysis and coding

For reliable micro-analysis of facial expressions of emotion made by infants and their mothers while the mothers were addressing them in the manner of infant-directed speech, the flow of spontaneous interaction had to be given a well-defined structure. To do this the mothers', speech was classified into thematic sequences, and these were grouped into units

[5] The recruitment procedure and recording arrangements have been recorded in more detail in the original study (Kokkinaki, 1998).

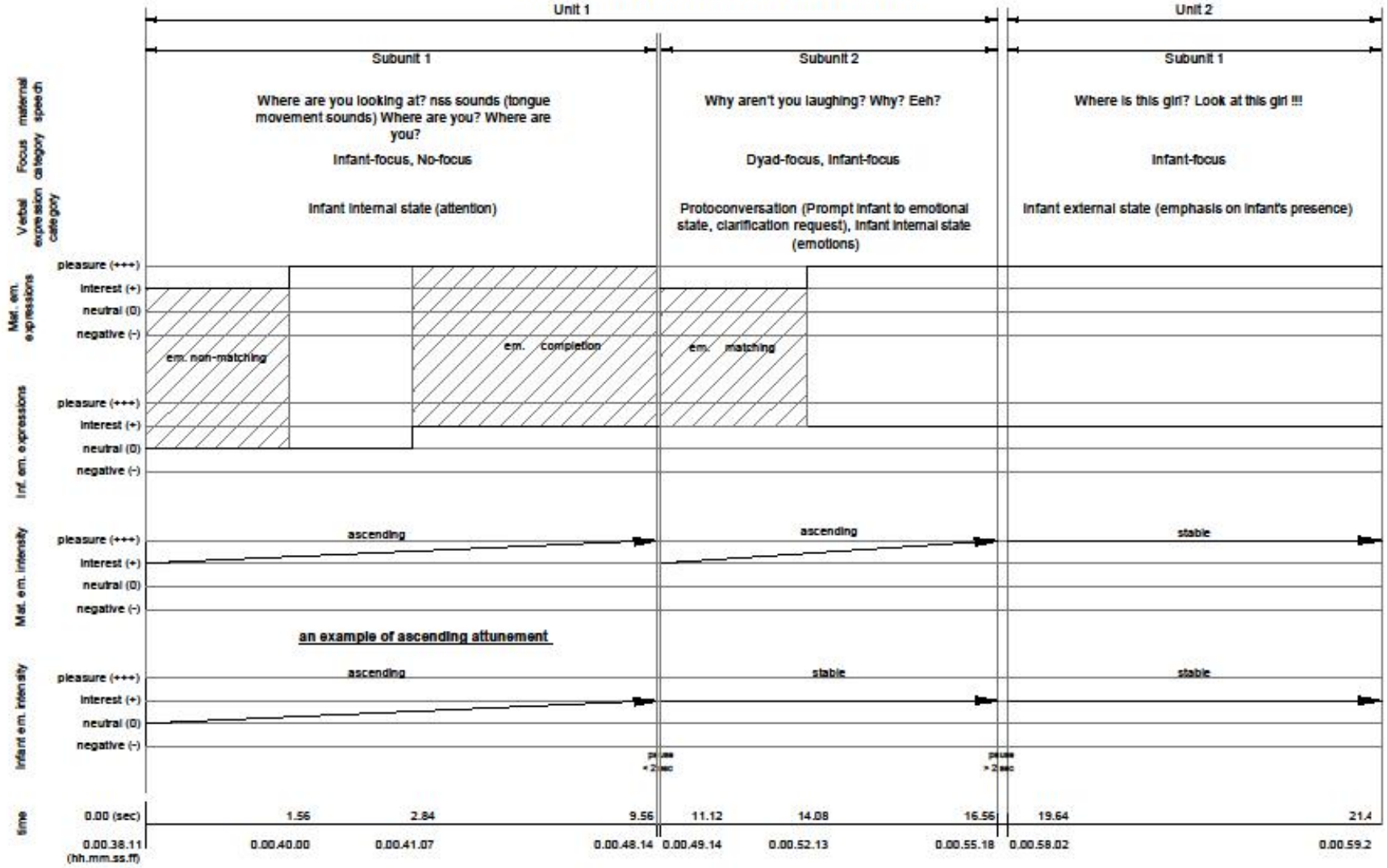
and subunits, according to the duration of the preceding and following pauses. The *unit* was defined as composed of one or more subunits depending on their separation in time. A sub-unit of analysis was defined as the event that began at the start of one thematic sequence of utterance and ended at its termination.

Units were identified as separated by intervals longer than 2 seconds. If the pause between successive subunits was shorter than or equal to 2 seconds, these were grouped within one unit. A 2-second pause has been judged adequate for determination of change of content of mothers' utterances to infants (Herrera, Reissland and Shepherd, 2004).

See Diagram I for an example of the microanalysis of a short engagement between a mother and her 2-month-old infant girl into interpersonal engagement categories within in units and sub-units.

Within each sub-unit of analysis, the facial expressions of emotion of the infant and the mother were grouped into interpersonal engagement categories as these were defined above: (a) the *type* of facial expressions of emotion, and for each category the *direction* (who

Diagram: An example of micro analysis and segmentation procedure of interpersonal engagement categories in spontaneous mother-2-month-old infant girl interaction



performed first) was recorded; (b) the *frequency* of emotional shifts, and the frequency of emotional expressions; and (c) the *intensity* of emotional expressions.

Interpersonal engagement categories, according to the type of facial expressions of emotion

Microanalysis of infant and maternal facial expressions of emotions was carried out to distinguish four types of facial expressions: 1) *happy*, which includes: a) pleasure directed to the partner, or b) pleasure directed to the external world; 2) *interested*: a) directed to the partner, or b) directed to the external world; 3) *neutral* expressions; and 4) *sad or withdrawn* expressions (see Photographs I and II for examples of infant and maternal types of facial expressions; see Kokkinaki, 1998; Kokkinaki and Vasdekis, 2015 for full descriptions of these expressions and the theoretical background for distinguishing them). Interpersonal engagement categories for the *type* of facial expressions of emotion were coded *as*: a) *matching*, b) *completion*, and c) *non-matching.*

Emotional matching was coded when one partner expressed the type of facial expression of emotion of the other partner (see Diagram 1, Unit 1: Subunit 2, both the mother and the infant express interest to each other; see also Photograph III.C for an episode of emotional matching of happiness).

Emotional completion was coded when one partner expressed a different intensity of the positive valence of facial expression of emotion of the other partner (see Diagram 1, Unit 1: Subunit 1, the mother shows pleasure in response to the infant while the infant is interested in the mother;

(1a) grin

(1b) smile

(1c) bright smile

(1d) laughter

(2a) reversed U-shape mouth

(2b) “pre-speech” mouth movements

(2c) intense look at the mother (immobile arms and stretched legs)

(2d) wide open eyes

(2e) frowning

(3a) sleepiness

(3b) sleepiness

(3c) interest to external world

(4) whimper

Photographs I: Facial expressions of a 2-month-old girl illustrating different emotions in spontaneous interactions with the mother.

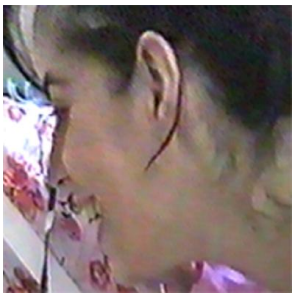
(1) – expressions of *pleasure* shared with the parent;

(2) – expressions of *interest* in the parent;

(3) – *neutral* or non-social emotional expression;

(4) – a *negative* interpersonal expression of distress.

(1a) grin



(1b) smile

(2a) interest expression

(2b) raised eye brows and wide open eyes

(2c) blinking

(3a) self-absorbed

Photographs II: Facial expressions of a mother illustrating different emotions in spontaneous interactions with her infant.

1 – expressions of *pleasure* shared with the infant;

2 – expressions of *interest* in the infant;

3 – *neutral* or non-social emotional expression.

see also Photograph III.B, the mother is showing her pleasure to the infant while the infant is looking at the mother with an expression of intense interest).

Emotional non-matching was coded when neither the infant nor the mother showed interest in interacting with the other (see Diagram 1, Unit 1: Subunit 1, the mother is interested in the infant while the infant expresses a neutral emotion; see also Photograph I.3c, where the mother is looking and talking to her infant in a relaxed way while the infant shifts her attention to the left). Due to the low percentage of emotional expressions that could be defined as 'stable' (1270 subunits, 29.8%), interpersonal engagement categories were coded at each time point in a subunit of analysis. Thus, in the course of one subunit, continuous microanalysis of non-stable emotional expressions entailed combinations of different interpersonal engagement categories (e.g. in Diagram 1; Unit 1, Subunit 1 there is a combination of emotional non-matching and completion).

Direction of interpersonal engagement categories

One feature that comes out from the timing of non-stable dyadic emotional expressions is the direction of exchange of emotional expressions in the dyad; that is, which partner matched first, or completed first the emotional state which had been expressed by the other partner, or which was the first to cause non-matching. Thus in Diagram 1; Unit 1: Subunit 1-Subunit 2, while mother expresses pleasure and the infant is interested in the mother, the mother is the one that shifts *first* from pleasure (Subunit 1) to interest expression (Subunit 2), thus in this case, the mother causes emotional matching.

A. 00.02.03.16: In the course of mutual expressions of intense interest and eye contact the mother starts a rhythmic vocal game.

B.00.02.04.14: The infant intensifies her interest expression. The mother shifts to a pleasure expression and she continues the vocal game while she enriches it with a rhythmic touching pattern on the face of the infant.

C.00.02.05.16: At the culmination of the touching pattern and the vocal game the mother intensifies her pleasure expression and the infant "shares" the pleasure expression with her mother.

D.00.02.22.14: After a short 'negotiation' of pleasure and interest expressions, the infant shifts her attention to the left while the mother is looking at her with a pleasure expression. After 10 25ths of a second, the mother also shifts her attention to the infant's pacifier.

Photographs III: An episode of Emotional Matching of Pleasure between a 2.5-month-old girl and her mother (the first two digits represent the time in hours, the second two in minutes, then in seconds and in twenty-fifths of a second).

Interpersonal engagement category according to the frequency of emotional shifts and emotional expressions

S*ynchrony of emotional shifts* was coded when one partner matched the frequency of change of emotional expressions of the other partner - irrespectively of the type of emotional expressions (see Diagram 1, Unit 1: Subunit 1, the mother changes her facial expression from interest to pleasure and the infant shifts from neutral to interest, that is, both partners shift from one emotional expression to the other once in the course of the same subunit of 'dialogue'). *Synchrony of emotional expressions* was coded when one partner matched the frequency of facial expressions of emotions of the same type of the other partner (e.g. both the mother and the infant express happiness to the partner twice within the same subunit of 'dialogue').

Interpersonal engagement categories according to emotional intensity change

Each partner's emotional intensity change over time was described according to the 'valence' of the facial expression directed to the partner or to the external world, which was represented by a symbol: negative valence, a sad emotional expression (-); neutral valence or neutral emotional expression (0); positive valence: interest to the partner (+), pleasure to the external world (++), pleasure to the partner (+++). The sequence of emotional valence symbols of each partner in the course of each sub-unit of maternal infant-directed speech determined four categories for emotional intensity change: *ascending, descending, stable* and *fluctuating*.

Ascending emotional intensity was coded when the emotional valence of the last emotional state of one partner, at the end of the subunit, is higher in the scale than the valence of the first emotional state of the same partner, in the beginning of the subunit, e.g. when the infant shifts from interest directed to the mother (+) to pleasure to the mother (+++). See

Diagram, Unit 1, Subunit 1 for an example of maternal and infant ascending emotional intensity in the course of which the mother shifts from interest (+) to pleasure (+++) and the infant shifts from neutral (0) to interest (+). See also Photograph III.B to III.D, the infant shifts from interest directed to the mother (+) to pleasure directed to her (+++) and then to pleasure directed to the external world (++).

Descending emotional intensity was coded when the valence of the last emotional state of one partner is lower in the scale than the valence of the first emotional state of the same partner; e.g. when interest to the partner (+) in the beginning of the subunit ended into a negative facial expression (-).

Fluctuating emotional intensity was coded when the valence of the first and the last emotional state of one partner is the same in position in the scale while the intermediate valence(s) differ, e.g. when interest to the partner (+) is followed by negative emotion (-) and this is followed by interest to the partner again (+).

Stable emotional intensity was coded when the valence of the emotional state of one partner remained the same in the whole course of the subunit (see Diagram 1, Unit 1: Subunit 2, for an example of infant stable emotional intensity in which the infant expressed interest to the mother throughout the subunit of 'dialogue').

As with the categories of emotional intensity change, the matching in the sequence of both partners' emotional valence symbols in the course of one sub-unit of maternal infant-directed speech was determined within four categories of *attunement*: *ascending, descending, stable* and *fluctuating*. For example, *ascending attunement* was coded when the last emotional state of both partners', at the end of the subunit, is higher in the scale than the valence of the first emotional state of both partners, in the beginning of the subunit (see Diagram 1, Unit 1: Subunit 1 for an example of ascending emotional attunement).

Inter-observer reliability assessments of a random sample of 33% of video-files for the *type*, the *valence* and the *intensity* of infant and maternal facial expressions of emotion ranged from 0.76 to 0.84, from 0.79 to 0.88, and from 0.77 to 0.85, respectively. Inter-observer reliability ranged totally from 0.76 to 0.88, the mean value of k (Cohen's kappa) being 0.82. Fleiss (1981) characterizes kappas over 0.75 as excellent.

Statistical analysis

For the statistical analysis, the chi-square test of independence was used to determine possible relationships between pairs of categorical variables. The longitudinal dependencies of the data of this study (repeated observations in time obtained on a relatively small number of subjects) would tend to increase the number of significant results. For this reason, the significance level was set at 1% (instead of 5%), as a safeguard against false rejections of the null hypothesis, increasing therefore the power of the test. In the case of a significant relationship, adjusted residuals were calculated to indicate categories that deviate from the independence assumption (Dobson, 2002).

In cases where proportions of two-outcome analyses were assessed (i.e., frequency of units and subunits of analysis in interactions of mothers with infant girls and boys), Binomial test was used to test equality of outcomes. The significance level for the Binomial test was set at 5%. Further, Friedman test (with sliding windows) was used to explore possible age-related changes of emotional coordination categories and non-matching across the nine (9) data points. Through Friedman analysis, we took into consideration the fact that at each age point and for each infant-mother dyad of this sample we had different number of subunits. The significance level for Friedman test was Bonferroni corrected and set at 5 / 4 (number of

comparisons) = 1.25%. For each category of dyadic emotional expression, four (4) comparisons were carried out, one every 3 age points.

Results

Units and sub-units of analysis for interactions of infant girls and infant boys with their mothers

Units of analysis of maternal infant-directed speech were more frequent in dyadic interactions of mothers with girls (459, 58%) compared to those with boys (338, 42%) [2-tailed Binomial test, $p<0.001$]. Similarly, the frequency of subunits in infant girl-mother interactions (2,512, 59%) outnumbered significantly the frequency of subunits in infant boy-mother interactions (1,753, 41%) [2-tailed Binomial test, $p<0.001$].

*Infant sex effect on interpersonal engagement categories according to the **type** of facial expressions of emotion (Hypothesis 1a)*

An infant sex effect on the relationship between infant and maternal emotions [Table 2, rows (1a) and (1b), Note 2] provided evidence of *stronger emotional matching and completion in infant girl-mother interactions compared to infant boy-mother interaction.* In connection to this, infant girls were more likely than infant boys to be pleased (4.9% vs 2.8%, respectively, *emotional matching*) when the mother was expressing pleasure than when the mother was showing interest in them (2% and 0%, respectively). Infant girls were more likely than infant boys to be interested in the mother when she was pleased (20.8% vs 15.6%, respectively, *emotional completion*) than when she was interested in them (16.3% and 7.8%, respectively). Further, *emotional non-matching was stronger and more frequent in infant boy-mother interactions compared to infant girl-mother interactions.* In connection to this: a) infant boys

Table 2: Summary table of analysis of the relationship between infant and maternal types of facial expressions of emotion, frequency of change of emotional expressions, emotional intensity and infant and maternal emotions in the beginning and at the end of maternal infant-directed speech in spontaneous interactions of mothers with their infant girls and infant boys.

	Pearson Chi-Square	**df**	**Asym. Sig. (2-sided)**
1.Relationship between infant and maternal types of facial emotional expressions			
(a) Infant girl-mother interactions	130.00	4	<0.001
(b) Infant boy-mother interactions	153.42	4	<0.001
2. Relationship between infant and maternal frequency of change of emotional expressions			
(a) Infant girl-mother interactions	88.64	4	<0.001
(b) Infant boy-mother interactions	51.67	4	<0.001
3. Relationship between infant and maternal frequency of change of pleasure expressions			
(a) Infant girl-mother interactions	18.66	4	<0.001
(b) Infant boy-mother interactions	19.22	4	<0.001
4. Relationship between infant and maternal frequency of change of interest expressions			
(a) Infant girl-mother interactions	41.86	4	<0.001
(b) Infant boy-mother interactions	13.43	4	<0.01
5. Relationship between infant and maternal emotional intensity			
(a) Infant girl-mother interactions	220.04	9	<0.001
(b) Infant boy-mother interactions	131.36	9	<0.001
6. Relationship of infant emotions in the beginning and at the end of a -unit			
(a) Infant girl-mother interactions	1970.44	16	<0.001
(b) Infant boy-mother interactions	1249.91	16	<0.001
7. Relationship of maternal emotions in the beginning and at the end of a sub-unit			
(a) Infant girl-mother interactions	612.17	4	<0.001
(b) Infant boy-mother interactions	582.70	4	<0.001

expressed *external interest more frequently than infant girls* when mothers were *pleased* to them (47.9% vs 41.8%) than when their mothers were interested in them (39.4% vs 34.7%, respectively) (*emotional non-matching*); and b) infant boys were negative in emotion more than infant girls when mothers were interested in them (28.8% vs 21%) than when their mothers were pleased (8.3% vs 6.4%) (*emotional non-matching*).

*Infant sex effect on interpersonal engagement category according to the **frequency** of facial expressions of emotion (Hypothesis 1a)*

The infant sex effect on the relationship between infant and maternal frequency of changes of emotional expressions - irrespective of the type of facial expression of emotion [Table 2, rows (2a) and (2b)] - provided evidence that *emotional synchrony was stronger and more accurate for infant girls compared to interactions with infant boys.* In this connection, when maternal expressions remained stable, changed once, or changed twice, it was more probable that infant girls' emotional expressions remained stable (59%), rather than changed once, or twice (vs 39.6% or 30.3%); changed once (34.2%), rather than remained stable, or changed twice (vs 25.3% or 24.8%); or changed twice (45%), rather than remained stable or changed once (vs 15.7% or 26.3%), respectively. For infant boys, the relationship between infant and maternal frequency of changes of emotional expressions was significant only for the cases in which maternal expressions remained stable (56.9% vs 36.4% and 29.6%), or changed only twice (45.1% vs 17.3% and 30.9%). Nevertheless, *pleasure synchrony* was stronger in interactions of the mother with a girl, compared to those with a boy, but it was also stronger in instances where boys showed unchanged pleasure expressions (79.8% vs 63% and 55.2%) compared to girls in interactions with the mother (77.4% vs 60.4% and 61.1%) [Table 2, rows (3a) and (3b)]. The evidence of stronger and more accurate *emotional synchrony* in

engagements with girls compared to those with boys was verified when analysis was restricted in the *emotional expressions of interest* [Table 2, rows (4a) and (4b)].

*Infant sex effect on interpersonal engagement categories according to the **intensity** of facial expressions of emotion (Hypothesis 1a)*

An infant sex effect on the relationship between infant and maternal emotional intensity categories [Table 2, rows (5a) and (5b)] provided evidence of *stronger and more accurate emotional attunement in interactions of mothers with infant girls compared to infant boys*. Girl-mother pairs ascend (33.8%), or remain stable in emotional intensity (52.6%) more frequently than boy-mother dyads (26.6% and 49.2%, respectively). Girls' and boys' emotions descended and fluctuated in intensity almost to the same extent according to maternal descending and fluctuating intensity (descending: 23.3% and 23.5%; fluctuating: 33.8% and 34.0%, respectively). Nevertheless, when the category of attunement of stable emotional expressions was excluded from the analysis, attunement of ascending, descending and fluctuating intensity of emotional expressions was verified only in infant girl-mother (x^2= 20.19 , df=4, $p<0.001$) but not in infant boy-mother pairs (x^2=5.24, df=4, p=0.263).

*Infant sex effect on interpersonal categories of engagement according to both the **intensity** and **type** of facial expressions of emotion (Hypothesis 1b)*

Chi-square analysis was carried out to investigate the relationship between infant sex and interpersonal engagement categories according to the combination of the intensity and the type of facial expressions of emotion. This analysis verified the evidence of *stronger emotional matching* in infant girl- compared to infant boy-mother interaction (13.5% vs 6.4%), and the evidence of *more frequent emotional non-matching* in infant boy- compared to

infant girl-mother interactions (73.6% vs 62.8%) for the cases of *stable* infant and maternal emotional expressions in the course of the subunit (x^2=21.24, df=2, p<0.001). Further, for the cases of *non-stable* infant and maternal emotional expressions over the whole subunit of analysis, *the combination of emotional matching/completion* was more likely to occur with the girls compared to those with boys (13.7% vs 6.8%), while the combination of *emotional matching/non-matching* along with intermittent emotional non-matching were more likely to occur in interactions with boys (18.6% and 13.9%, respectively) compared to those with girls (vs 15.8% and 11.1%, respectively) (x^2=41.63, df=4, p<0.001).

*Infant sex effect on the **direction** of interpersonal engagement categories (Hypothesis 2)*

The significant relationships between infant sex and the direction of emotional matching and emotional non-matching provided evidence that: a) infant girls initiated matching of their mothers' emotional expressions (84.5%) more frequently than infant boys (75.2%), while mothers matched the emotions of their infant boys (24.8%) more than mothers of infant girls (15.5%) (x^2=22.49, df=1, p<0.001); and b) infant girls initiated emotional non-matching (95.2%) more frequently than infant boys (88.6%), while mothers of boys respond with a non-matching emotional expression to their infant more than mothers of girls (x^2=32.09, df=1, p<0.001). The relationship between infant sex and the direction of emotional completion was non-significant (x^2=0.29, df=1, p=0.58) (Note 3).

*Infant sex effect on the **relationship** of infant and maternal facial expressions of emotion between the beginning and the end of maternal infant-directed speech (Hypothesis 3)*

An infant sex effect on the relationship between infant emotions in the beginning and at the end of maternal speech [Table 2, rows (6a) and (6b)] provides evidence that when both girls

and boys were 'pleased', 'interested' in the mother, or in the external world, 'neutral' or 'negative' in emotion at the beginning of the mother's speech, they were more likely to express the same emotional expressions at the end. It should be noted that this kind of *emotional consistency was stronger for 'pleasure', 'interest' and 'neutral' expressions of girls*, (48.2%, 53.5% and 55.0%, respectively) compared to boys (vs 35.4%, 50.4% and 53.5%, respectively), while *within-infant emotional consistency was slightly stronger for 'external interest' and 'negative' emotion expressed by boys* (68.7% and 55.3%, respectively) compared to girls (vs 63.8% and 54.7%, respectively).

An infant sex effect on the relationship between maternal emotions in the beginning and at the end of spontaneous maternal speech [Table 2, rows (5a) and (5b)] (Note 4) provided evidence of *more intense emotional consistency* for mothers of boys compared to mothers of girls. Mothers of engaged with boys were more likely to remain 'pleased' or 'interested', in the infant or in the external world, in the beginning and at the end of their infant-directed speech (88.5%, 61.7%, 16.7%, respectively) than mothers of girls (88.3%, 57.5% and 3.0%, respectively).

*Infant age effect on interpersonal categories of engagement according to the **type** of facial expressions of emotion (Hypothesis 4)*

Friedman test analysis provided evidence of non-significant infant age effect on the emotional matching, completion and non-matching taking place in the mothers' interactions with girls and boys (Table 3).

Table 3: Summary table of Friedman test analysis (with sliding windows) comparing the emotional matching, completion and non-matching taking place in infant girl- and infant boy-mother interactions across 3 age points (4 comparisons for each interpersonal engagement category), in the course of the 2nd to the 6th month of infants' life (N=6 infant girl- and 5 infant boy-mother dyads).

	Chi-Square	**Asym. Sig.**
Emotional Matching		
Infant Girl-Mother Interaction		
Comparison (1): 2 - 2.5 - 3 months	5.33	0.06
Comparison (2): 3 – 3.5 - 4 months	0.33	0.84
Comparison (3): 4 – 4.5 – 5 months	1.00	0.60
Comparison (4): 5 – 5.5 – 6 months	1.33	0.51
Infant Boy-Mother Interaction		
Comparison (1): 2 - 2.5 - 3 months	4.80	0.09
Comparison (2): 3 – 3.5 - 4 months	0.10	0.94
Comparison (3): 4 – 4.5 – 5 months	0.73	0.69
Comparison (4): 5 – 5.5 – 6 months	4.80	0.09
Emotional Completion		
Infant Girl-Mother Interaction		
Comparison (1): 2 - 2.5 - 3 months	0.00	1.00
Comparison (2): 3 – 3.5 - 4 months	1.09	0.58
Comparison (3): 4 – 4.5 – 5 months	0.00	1.00
Comparison (4): 5 – 5.5 – 6 months	2.33	0.31
Infant Boy-Mother Interaction		
Comparison (1): 2 - 2.5 - 3 months	2.80	0.24
Comparison (2): 3 – 3.5 - 4 months	2.00	0.36
Comparison (3): 4 – 4.5 – 5 months	2.80	0.24
Comparison (4): 5 – 5.5 – 6 months	6.40	0.04
Emotional Non-Matching		
Infant Girl-Mother Interaction		
Comparison (1): 2 - 2.5 - 3 months	1.13	0.56
Comparison (2): 3 – 3.5 - 4 months	0.33	0.84
Comparison (3): 4 – 4.5 – 5 months	4.36	0.11
Comparison (4): 5 – 5.5 – 6 months	2.69	0.26
Infant Boy-Mother Interaction		
Comparison (1): 2 - 2.5 - 3 months	2.63	0.29
Comparison (2): 3 – 3.5 - 4 months	0.73	0.69
Comparison (3): 4 – 4.5 – 5 months	0.94	0.62
Comparison (4): 5 – 5.5 – 6 months	1.20	0.54

The developmental curves of emotional matching for both girls and boys interacting with their mothers follow different patterns from the 2 to 5 months, and after the 5.5 months (Figure 1).

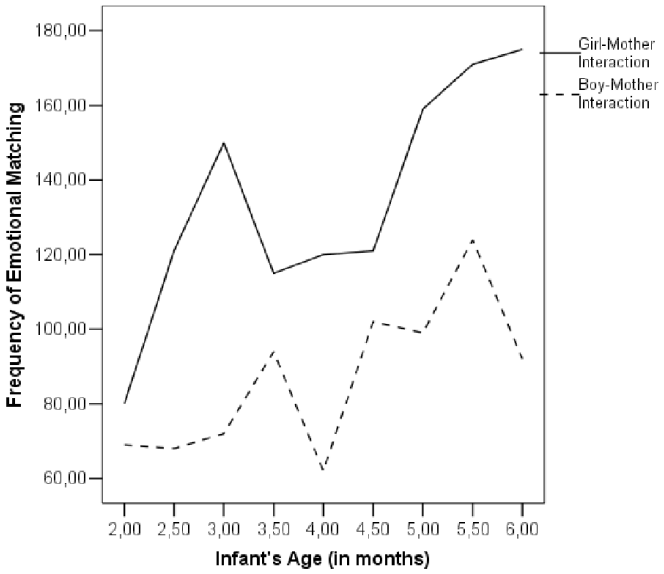


Figure 1: Developmental trajectories of *emotional matching* for infant girls and boys in interactions with their mothers.

Comparing interactions of mothers with girls and boys, the developmental curves of emotional completion follow similar patterns for both sexes across the age range from 2 to 6 months (Figure 2).

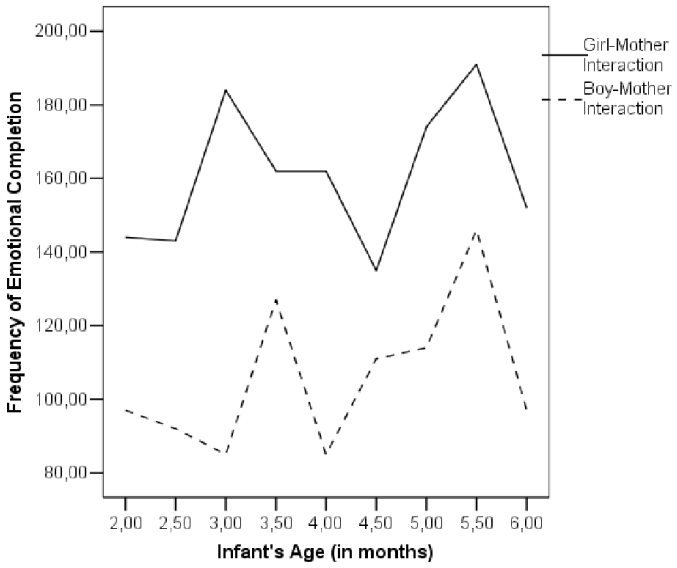


Figure 2: Developmental trajectories of *emotional completion* for infant girls and boys in interactions with their mothers.

The comparison of the developmental patterns of emotional non-matching provided evidence of similar patterns from 2.5 to 5.5 months for infant girls and boys (Figure 3).

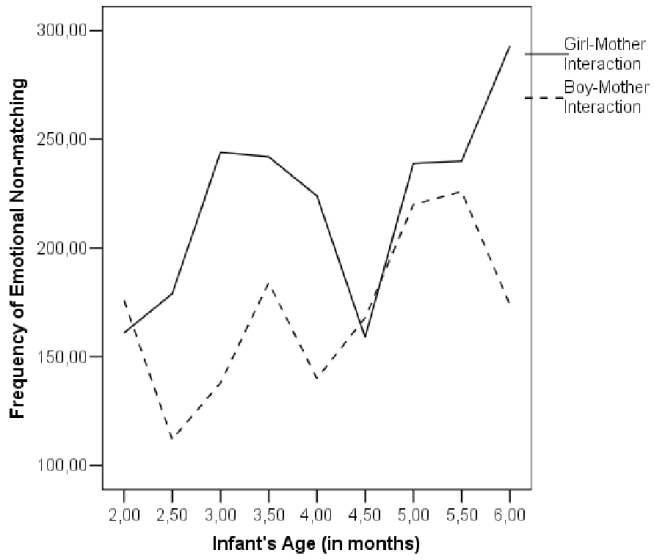


Figure 3: Developmental trajectories of *emotional non-matching* for infant girls and boys in interactions with their mothers.

Figures 1, 2 and 3 provide evidence of U-shaped developmental curves - at 4 months - for all the categories of interpersonal engagements in boy-mother interaction, and at 4.5 months for emotional completion and non-matching in girl-mother dyads.

Discussion

We compared systematically *emotional coordination* and *non-matching* in spontaneous dyadic interactions of girls and boys with their mothers in the first 6 months after birth.

This preliminary study provided evidence of differences between the sexes which are summarized as supporting the following hypotheses outlined above: (1a) emotional coordination (matching, completion, synchrony and attunement) was stronger and more accurate in dyads of mothers with girls compared to those with boys, while emotional non-matching was stronger and more frequent for the boys; (1b) the combination of emotional matching/completion was more likely to occur with girls, while the combination of emotional matching/non-matching along with intermittent emotional non-matching were more likely to occur with boys; (2) girls initiated matching of their mothers' emotions and caused non-matching more frequently than boys.

Mothers match boys' emotions and respond with a non-matching emotional expression more than those who are with girls; (3) *emotional consistency* was stronger for pleasure, interest and neutral expressions of girls, while within-boys' emotional consistency was stronger for external interest and negative emotion compared to girls. Mothers of boys showed more intense emotional consistency than girls' mothers. In confirmation of Hypothesis 4, the developmental trajectories of emotional matching and non-matching follow different patterns in the two types of dyads across the age range of this study.

This evidence verified most of our initial hypotheses, in agreement with Feldman (2003) who reported closer synchrony between same-gender dyads, and contradict those of Malatesta and Haviland (1982), Tronick and Cohn (1989) and Weinberg et al. (1999).

We confirm that mother-infant *emotional coordination* supports adjustment of timing (kinematics), form (physiognomics) and energy (energetics) of emotional expressions to obtain inter-subjective synchrony and 'subjective coherence' of their intentions and interests (Trevarthen, 1993b; Kokkinaki and Vasdekis, 2015). In particular, as early as the second month of infant's life, the evidence of *emotional matching*, *completion, attunement and within-infant and within-mother emotional consistency* is consistent with the assumptions that: a) intersubjective communication requires the infant to interact with the Other in a *matching* and self-coordinated *actively-attuned* way; b) the expressed states of feelings in either one of the partners are evidently *incomplete* or *open*, anticipating a particular range of possible reactions of feelings in the expressions of the partner; a communicating subject is trying to make an effective complementary reply; and c) infants can experience both self-awareness and other-awareness as well as awareness of purposeful sharing of emotional states (Trevarthen, 1993a, 1993b, 1997, 2005).

Further, this study provided evidence of sex-related differences in the transitions of interpersonal engagement categories. *Transitions between emotional matching and completion* were more likely to occur in mother's communications with girls compared to those with boys, while *transitions between emotional matching and non-matching* along with *intermittent emotional non-matching* were more likely to occur in with boys.

Given that *emotional matching, completion and non-matching* presupposes the close following of emotions between persons in the short term, the evidence of transitions between these interpersonal engagement categories is consistent with the concept of "emotional

narratives" as the coordination through time of cognitive dynamics, attention shifts, and changes in motive force in each self, and between selves (Trevarthen, 1993a, 1993b, 1997). In girl-mother interaction, interpersonal engagements "unfold" gradually and the sharing of feelings (*matching*) is expressed in balance with chaining and grouping of emotional expressions, which are brought into close harmony by smooth continuation (*completion*). In contrast, *emotional sharing* in boy-mother communication is frequently qualified by strategic interruption, expressed through inappropriateness in forms of emotions (*non-matching*). Interruption signifies that the motivation for communication changes towards a different physiognomy indicative of agitation, distress and need for attention to some internal physiological need, or for comfort. Periods of emotional non-matching constitute "re-negotiations" of intentions, or subtle varieties of motive adjustment in the course of which the brains of both participants (mother and infant) still continue to be re-organized. Using more sophisticated longitudinal analyses such as GLIMMIX, or transitional probabilities to model change over time in each individuals' behavior as a function of the others' within a dyad, may extend our understanding on how mother and infant change with respect to one another.

The fluctuating and different developmental trajectories of emotional matching and non-matching in communications with boy and girl infants may support assumptions that: a) motives, expressed in emotions, are periodically re-organized and guided by perceptual experience that is sought to effectively complete each intended action; b) there is a constant competitive interaction between processes of cognition, perception and emergent individual action, and the psychological mechanisms that operate for social cooperation (Kokkinaki, 1998; Trevarthen, 1997).

Further, in this study girls initiated emotional matching and caused non-matching more than boys did. This psychological specialization appears to confirm that female's are more

actively involved than males in interpersonal responsibilities and communication (Trevarthen, 1986a). Moreover, mothers match boys' emotions and respond with a non-matching emotional expression more than mothers with girls do. This supports the conclusion that boys, because of their greater difficulty in maintaining their affective regulation, will be more dependent on their mothers to help them regulate affective states (Weinberg et al., 1999). Regarding the occurrence of non-matching emotional behaviours, it may be that the rate at which mismatching states were repaired to matching states was slower for mother-son dyads than it was for mother-daughter dyads (Weinberg et al., 1999) and the segmentation procedure we employed was not appropriate for this longer recovery time. Alternatively, it may be that boys engage in emotional negotiations *at different rates, or in different order* depending on the interpersonal challenges they are exposed to in their social engagements.

Notwithstanding these problems, *variations* in timing, form and energy adjustment between interactions of mothers with girls and boys are indirectly supported by: a) different patterns in the ways girls and boys *coordinate or cause non-matching* to the type, the frequency, the valence and the intensity of maternal facial expressions at all ages through the period studied; (b) differences in the transitions of interpersonal engagement categories between girls and boys; and (c) differences of emotional consistency between girls and boys, and between mothers of girls and mothers of boys.

Given the segmentation procedure we used (see Method), these variations provide evidence that early in life emotional engagements in girl-mother pairs are structured in more frequent and shorter duration - thus more intense - temporal cycles than that of boy-mother dyads. These are the kind of variations that may be attributed to sex-related differences in brain development, certain of which are evident in the fetal period, and the association of

these with sex differences in perception, motivation and patterns of emotion regulation that seem to favour stronger affective reactions for girls in infancy.

Sex differences known at different stages of development may be summarized as related to the following: (a) brain volumetric asymmetries (de Lacoste, Horvath and Woodward, 1991); (b) the microarchitecture of the brain structure and the brain networks related to emotional awareness called 'empathy' (Baron-Cohen et al., 2005; Schulte-Rüther et al., 2008); (c) attention and memory for specific emotional cues (Wager and Ochsner, 2005), (d) reaction speeds (Leppanen and Hietanen, 2001) and the chronometry of emotional responses (Germans Gard and Kring, 2007); (e) the neural basis of emotional memories (Canli, Desmond, Zhao and Gabrieli, 2002); (f) face processing in visual perception (Rennels and Cummings, 2015), the maturation and the development of functions mediated by the amygdala and the temporal cortex which play role in processing of other persons' facial emotional expressions (McGlure, 2000) and the functional specialization of brain areas devoted to face processing in general (Proverbio et al., 2006); (g) the latency to emotional expression and duration of emotional expression (Losonczy-Marshall, 2008); (h) motivational differences (Christov-Moore et al., 2014); (i) accuracy in recognizing subtle rather than highly expressive or exaggerated facial displays of emotion (Hoffman et al., 2010); (j) emotional regulation according to exposure time (Sonnby-Borgstrom, Jonsson and Svensson, 2008); and (k) the intensity of emotional expression (Brody, 1997). It is noteworthy that infants' arousal during mother-infant interaction is mostly organized by cyclic oscillations between *low* and *medium states of arousal* (Feldman, 2003), which may favour the emotional adaptations of females.

The evidence we have found of differences in emotional regulation of engagements between girls and boys with their mothers appears related to fundamental dimensions of

intersubjective motor control for communication by body movement: namely “kinematics”, “physiognomics” and “energetics” (Stern, 1985, 2010; Trevarthen, 1986b). These dimensions of motor vitality relate to the expression of psychological wellbeing and particularly for individuals’ ability to regulate learning and memory and negotiate interpersonal challenges within and outside the family interactional context (Feldman, 2003; Kokkinaki and Vasdekis, 2015; Trevarthen, 1997; Weinberg et al., 1999). In summary, the “The sex differences in (human) brains may help keep intact the complex balance of private self-discovery, exploration of nature, leadership, cooperation, communication, and imitation that vitalizes human communities and makes culture possible” (Trevarthen, 1986a, p. 198). Male and female individuals discover different responsibilities in the use of their emotional abilities in their relational life.

The results obtained in this exploratory study need to be interpreted with caution. We must take into account the short-time observations of a small number of participants in each group, with unequal distribution according to birth order, and the fact that all came from Greek middle-class families. Longitudinal studies with larger samples and with cross-cultural and within-cultural comparisons, providing data for all four parent gender by infant gender pairs, which investigate systematically the frame-by-frame chronometry of emotional ‘dialogues’ for an extended period of time, may yield different information on the contribution of sex-related variations in emotional communication in the development of human social consciousness and its variation with culture.

We acknowledge that understanding of the development of intersubjective awareness with affective attunement advanced so richly by Daniel Stern (as reviewed by Papastathopoulos, in this volume) needs special recognition. Stern’s approach and findings have greatly benefitted scientific study of how children and their parents are motivated to

collaborate intimately in transmission of the principles and values of creative cultural life, from early infancy.

Notes and acknowledgments

1. Participants were part of a longitudinal study of emotional expressions and spontaneous imitations in interactions between infants and parents, both mothers and fathers, in 30 families, fifteen from Crete, Greece and fifteen from Edinburgh, Scotland (N=90 subjects). For the present study, eleven mother-infant pairs were taken non-selectively from the Greek sample only. The video recordings used in this study were made for the PhD of the researcher at the Department of Psychology, University of Edinburgh, under the supervision of Prof. Colwyn Trevarthen. Ethical approval for their use was granted by the Royal Infirmary of Edinburgh, NHS Trust (8/95). I am thankful to the parents of the infant presented in Photographs I, II and III for their permission to reproduce these images. I am also deeply indebted to the infants and their families for "sharing" their time, cooperation and patience to participate in this study.

2. In order to avoid low frequency cells in the analysis of the birth-order effect on interpersonal engagement categories according to the type of facial expressions of emotion, analysis was carried out for the relationship between each and every infant emotion and the predominant maternal emotions, that is, maternal pleasure and interest.

3. The analysis of the direction of interpersonal engagement categories was carried out only for the first instance of emotional matching, completion and non-matching within the course of the subunit.

4. In order to avoid low frequency cells in the analysis of the birth-order effect on the relationship of maternal emotional expressions between the beginning and the end of

maternal infant-directed speech, analysis was restricted to maternal pleasure, interest and external interest.

References

Alexander, G. M., & Wilcox, T. (2012). Sex differences in early infancy. *Child Development Perspectives*, *6(4),* 400-406. Doi: 10.1111/j.1750-8606.2012.00247.x

Arnsten, A. F. T., & Pliszka, S. R. (2011). Catecholamine influences on prefrontal cortical function: Relevance to treatment of attention deficit hyperactivity disorder and related disorders. *Pharmacology Biochemistry and Behavior*, *99 (2),* 211-216. Doi: 10.1016/j.pbb.2011.01.020

Baron-Cohen, S., Knickmeyer, R. C., & Belmonte, M. K. (2005). Sex differences in the brain: Implications for explaining autism. *Science*, *310*, 819-823. Doi: 10.1126/science.1115455

Beebe, B. (1982). Micro-timing in mother-infant communication. In M. R. Kaye (Ed.), *Non-verbal Communication Today* (pp. 169-195). The Hague: Mouton.

Beebe, B., Jaffe, J., Feldstein, S., Mays, K., & Alson, D. (1985). Matching of timing: The application of an adult dialogue model to mother-infant vocal and kinesic interactions. In T. Field (Ed.), *Infant Social Perception* (pp. 217-249). Norwood, NJ: Ablex.

Birdwhistell, R. (1970). *Kinesics and Context.* Philadelphia: University of Pennsylvania Press.

Brody, L. R. (1997). Gender and emotion: beyond stereotypes. *Journal of Social Issues*, *53 (2),* 369-394. Doi: http://dx.doi.org/10.1111/0022-4537.00022

Canli, T., Desmond, J. E., Zhao, Z., & Gabrieli, J. D. E. (2002). Sex differences in the neural basis of emotional memories. *Proceedings of the National Academy of Sciences of the*

United States of America, *99 (16),* 10789-10794. (www.pnas.org/cgi/doi/10.1073/pnas.162356599).

Champagne, J., Lakis, N., Bourque, J., Stip, E., Lipp, O., & Mendrek, A. (2012). Progesterone and cerebral function during emotion processing in men and women with schizophrenia. *Schizophrenia Research and Treatment, 2012, Article ID 917901*. Doi:10.1155/2012/917901

Christov-Moore, L., Simpson, E. A., Coudé, G., Grigaityte, K., Iacoboni, M., & Ferrari, P. F. (2014). Empathy: Gender effects in brain and behavior. *Neuroscience and Biobehavioral Reviews*, *46*, 604-627. Doi: 10.1016/j.neubiorev.2014.09.001

Connellan, J., Baron-Cohen, S., Wheelwright, S., Batki, A., & Ahluwalia, J. (2000). Sex difference in human neonatal social perception. *Infant Behavior and Development*, *23*, 113-118. Doi: 10.1016/S0163-6383(00)00032-1

Cossette, L., Pomerlau, A., Malcuit, G., & Kaczorowski, J. (1996). Emotional expressions of female and male infants in a social and a nonsocial context. *Sex Roles*, *35*, 693-709. Doi: 10.1007/BF01544087

De Lacoste, M. C., Horvath, D. S., & Woodward, D. J. (1991). Possible sex differences in the developing human fetal brain. *Journal of Clinical and Experimental Neuropsychology*, *13(6),* 831-846. Doi:10.1080/01688639108405101

Dobkins, K. R., Bosworth, R. G., & McCleery, J. P. (2009). Effects of gestational length, gender, postnatal age, and birth order on visual contrast sensitivity. *Journal of Vision*, *9(10),* 1-21.

Dobson, A. J. (2002). *An Introduction to Generalized Linear Models*. London: Chapman and Hall.

Ellsworth, C. P., Muir, D.W., & Hains, S. M. J. (1993). Social competence and person-object differentiation: An analysis of the still-face effect. *Developmental Psychology*, *29*, 63-73.

Feldman, R. (2003). Infant-mother and infant-father synchrony: The coregulation of positive arousal. *Infant Mental Health Journal*, *24(1),* 1-23. Doi: 10.1002/imhj.10041

Field, T., Vega-Lahr, N., Goldstein, S., & Scafidi, F. (1987). Face-to-face interaction behavior across early infancy. *Infant Behavior and Development*, *10*, 111-116.

Fleiss, J. L. (1981). *Statistical Methods for Rates and Proportions*. New York: Wiley.

Fogel, A., Tota, S., & Kawai, M. (1988). Mother-infant face-to-face interaction in Japan and the United States: A laboratory comparison using 3-month-old infants. *Developmental Psychology*, *24*, 398-406.

Germans Gard, M., & Kring, A. M. (2007). Sex differences in the time course of emotion. *Emotion*, *7 (2),* 429-437. Doi:10.1037/1528-3542.7.2.429

Gilmore, J. H., Lin, W., Prastawa, M. W., Looney, C. B., Vetsa, Y. S. K., Knickmeyer, R. C., Evans, D. D., Smith, J. K., Hamer, R. M., Lieberman, J. A., & Gerig, G. (2007). Regional gray matter growth, sexual dismorphism, and cerebral asymmetry in the neonatal brain. *The Journal of Neuroscience*, *27(6),* 1255-1260. Doi:10.1523/JNEUROSCI.3339-06.2007

Guapo, V. G., Graeff, F. G., Zani, A. C. T., Labate, C. M., dos Reis, R, M., & Del-Ben, C. M. (2009). Effects of sex hormonal levels and phases of the menstrual cycle in the processing of emotional faces. *Psychoneuroendocrinology*, *34*, 1087-1094. Doi: 10.1016/j.psyneuen.2009.02.007

Gusella, J. L., Muir, D., & Tronick, E. Z. (1988). The effect of manipulating maternal behavior during the interaction on three- and six-month olds affect and attention. *Child Development*, *59*, 1111-1124. Doi: http://dx.doi.org/10.2307/1130278

Herrera, E., Reissland, N., & Shepherd, J. (2004). Maternal touch and maternal child-directed speech: effects of depressed mood in the postnatal period. *Journal of Affective Disorders*, *81(1),* 29-39. Doi:10.1016/j.jad.2003.07.001

Hittelman, J. H., & Dickes, R. (1979). Sex differences in neonatal eye contact time. *Merrill-Palmer Quarterly*, *25*, 171-184.

Hoffman, H., Kessler, H., Eppel, T., Rukavina, S., & Traue, H. (2010). Expression intensity, gender and facial emotion recognition: Women recognize only subtle facial emotions better than men. *Acta Psychologica*, *135*, 278-283. Doi: 10.1016/j.actpsy.2010.07.012

Hollingshead, A. B. (1975). *Four Factor Index of Social Status*. Unpublished Working Paper. Department of Sociology, Yale University, New Haven.

Kokkinaki, T. (1998). *Emotion and Imitation in Early Infant-Parent Interaction: A Longitudinal and Cross-cultural Study*. PhD thesis, Department of Psychology, University of Edinburgh, UK.

Kokkinaki, T., & Vasdekis, V. G. S. (2015). Comparing emotional coordination in early spontaneous mother-infant and father-infant interactions. *European Journal of Developmental Psychology*, *12(1),* 69-84. Doi: http://dx.doi.org/10.1080/17405629.2014.950220

Korner, A. F. (1972). Sex differences in newborns with special reference to differences in the organization of oral behaviour. *Journal of Child Psychology and Psychiatry*, *14*, 19-29.

Lasky, R. E., & Klein, R. E. (1979). The reactions of five-month-old infants to eye contact of the mother and of a stranger. *Merrill-Palmer Quarterly*, *25*, 163-164.

Lavelli, M., & Fogel, A. (2002). Developmental changes in mother-infant face-to-face communication: birth to 3 months. *Developmental Psychology*, *38(2),* 288-305. Doi: 10.1037//0012-1649.38.2.288

Leeb, R. T., & Rejskind, F. G. (2004). Here's looking at you kid! A longitudinal study of perceived gender differences in mutual gaze behaviour in young infants. *Sex Roles*, *50*, 1/2, 1-14. Doi: 10.1023/B:SERS.0000011068.42663.ce

Leppanen, J. M., & Hietanen, J. K. (2001). Emotion recognition and social adjustment in schoold-aged girls and boys. *Scandinavian Journal of Psychology*, *42*, 429-435. Doi: 10.1111/1467-9450.00255

Losonczy-Marshall, M. E. (2008). Gender differences in latency and duration of emotional expression in 7-through 13-month-old infants. *Social Behavior and Personality*, *36(2),* 267-274. Doi: 10.2224/sbp.2008.36 .2.267

Maccoby, E. E., Doering, C. H., Jacklin, C. N., & Kraemer, H. (1979). Concentrations of sex hormones in umbilical-cord blood: Their relation to sex and birth of infants. *Child Development*, *50*, 632-642. Doi: http://dx.doi.org/10.2307/1128928

Malatesta, C. Z., Grigoryev, P., Lamb, C., Albin, M., & Culver, C. (1986). Emotion socialization and expressive development in preterm and full-term infants. *Child Development*, *57*, 316-330. Doi: http://dx.doi.org/10.2307/1130587

Malatesta, C. Z., & Haviland, J. M. (1982). Learning display rules: The socialization of emotion expression in infancy. *Child Development*, *53*, 991-1003. Doi: 10.2307/1129139

Mayes, L. C., & Carter, A. S. (1990). Emerging social regulatory capacities as seen in the still-face situation. *Child Development*, *61*, 754-763. Doi: 10.1111/j.1467-8624.1990.tb02818.x

McClure, E. B. (2000). A meta-analytic review of sex differences in facial expression processing and their development in infants, children, and adolescents. *Psychological Bulletin*, *126 (3),* 424-453. Doi:10.1037//0033-2909.126.3.424

Moore, D. S. (2012). Sex differences in normal foetuses and infants: A commentary. *Child Development Perspectives*, *6(4),* 414-416. Doi: 10.1111/j.1750-8606.2012.00258.x

Nagy, E., Kompagne, H., Orvos, H., & Pal, A. (2007). Gender-related differences in neonatal imitation. *Infant and Child Development*, *16*, 267-276. Doi: 10.1002/icd.497

Nagy, E., Orvos, H., Bakki, J., & Pal., A. (2009). Sex-differences in Apgar scores for full-term neonates. *Acta Paeditrica*, *98*, 897-900. Doi: 10.1111/j.1651-2227.2009.01238.x

Proverbio, A. M., Brignone, V., Matarazzo, S., Del Zotto, M., & Zani, A. (2006). Gender differences in hemispheric asymmetry for face processing. *BMC Neuroscience*, *7: 44.* Doi: 10.1186/1471-2202-7-44.

Rennels, J. L., & Cummings, A. J. (2013). Sex differences in facial scanning: Similarities and dissimilarities between infants and adults. *International Journal of Behavioral Development*, *37(2*), 111-117. Doi: 10.1177/0165025412472411

Roe, M., & Beckwith, L. (1992, May). Gender differences in infant smiling to mother and stranger at two and three months. Paper presented at the *8th International Conference on Infant Studies, Miami, FL.*

Sakaki, M., & Mather, M. (2012). How reward and emotional stimuli induce different reactions across the menstrual cycle. *Social and Personality Psychology Compass, 6/1*, 1–17. Doi: 10.1111/j.1751-9004.2011.00415.x

Schulte-Rüther, M., Markowitsch, H. J., Shah, N. J., Fink, G. R., & Piefke, M. (2008). Gender differences in brain networks supporting empathy. *NeuroImage*, *42*, 393-403.Doi: 10.1016/j.neuroimage.2008.04.180

Sonnby-Borgstrom, M., Jonsson, P., & Svensson, O. (2008). Gender differences in facial imitation and verbally reported emotional contagion from spontaneous to emotionally regulated processing levels. *Scandinavian Journal of Psychology*, *49*, 111-122. Doi: 10.1111/j.1467-9450.2008.00626.x

Thoman, E. B., Leiderman, P. H., & Olson, J. P. (1972). Neonate mother interaction during breast feeding. *Developmental Psychology*, *6*, 110-118.

Toda, S., & Fogel, A. (1993). Infant response to the still-face situation at 3 and 6 months. *Developmental Psychology*, *29*, 532-538. Doi: 10.1037/0012-1649.29.3.532

Trevarthen, C. (1977). Descriptive studies in infant behavior. In H. R. Schaffer (Ed.), *Studies in Mother-Infant Interaction*: *The Loch Lomond Symposium* (pp. 227-270). London: Academic Press.

Trevarthen, C. (1984). Emotions in infancy: Regulators of contact and relationships with persons. In K. Scherer & P. Ekman (Eds.), *Approaches to Emotions* (pp. 129-157). Hillsdale, NJ: Erlbaum.

Trevarthen, C. (1986a). Form, significance and psychological potential of hand gestures of infants. In J. L. Nespoulous, P. Perron & A. R. Lecours (Eds.), *The Biological Foundation of Gestures: Motor and Semiotic Aspects* (pp. 149-202). Hillsdale, NJ: Erlbaum.

Trevarthen, C. (1986b). Development of intersubjective motor control in infants. In M. Wade & H. T. A. Whiting (Eds.), *Motor Development in Children: Aspects of Coordination and Control* (pp. 209-261). Dordrecht: Martinus Nijhof.

Trevarthen, C. (1993a). The self born in intersubjectivity: the psychology of an infant communicating. In U. Neisser (Ed.), *The Perceived Self: Ecological and Interpersonal Sources of the Self-knowledge* (pp. 121-173). New York: Cambridge University Press

Trevarthen, C. (1993b). The function of emotions in early infant communication and development. In J. Nadel & L. Camaioni (Eds.), *New Perspectives in Early Communicative Development* (pp. 48-81). London: Routledge.

Trevarthen, C. (1996). Lateral asymmetries in infancy: Implications for the development of the hemispheres. *Neuroscience and Biobehavioral Reviews*, *20(4),* 571-586.

Trevarthen, C. (1997). The nature of motives for human consciousness. *Psychology: The Journal of the Hellenic Psychological Society*, *4 (3),* 187-221.

Trevarthen, C. (2005). Action and emotion in development of cultural intelligence: why infants have feelings like ours. In J. Nadel & D. Muir (Eds.), *Emotional Development: Recent Research Advances* (pp. 61-91). Oxford: Oxford University Press.

Trevarthen, C. (2016). From the Intrinsic Motive Pulse of infant actions, to the Life Time of cultural meanings. In B. Mölder, V. Arstila & P. Øhrstrom (Eds.), *Philosophy and Psychology of Time* Springer Studies in Brain and Mind, Vol. 9. Dordrecht: Springer, 225-265. Doi: 10.1007/978-3-319-22195-3

Trevarthen, C., & Aitken, K. J. (2003). Regulation of brain development and age-related changes in infants' motives: The developmental function of 'regressive' periods. In M. Heimann (Ed.), *Regression Periods in Human Infancy* (pp. 107-184). Mahwah, NJ: Erlbaum.

Trevarthen, C., & Daniel, S. (2005). Disorganized rhythm and synchrony: Early signs of autism and Rett syndrome. *Brain and Development*, *27*, S25-S34 (Supplement 1 to Volume 27, November 2005). Doi: 10.1016/j.braindev.2005.03.016

Trevarthen, C., & Reddy, V. (2016, in press). Consciousness in infants. In S. Schneider & M. Velmans (Eds.), *Blackwell Companion to Consciousness, Second Edition.* Oxford: Blackwells.

Tronick, E. Z., & Cohn, J. F. (1989). Infant-mother face-to-face interaction: Age and gender differences in coordination and the occurrence of miscoordination. *Child Development*, *60*, 85-92. Doi: 10.2307/1131074

van Honk, J., Schutter D. J., Bos, P. A., Kruijt, A-W., Lentjes, E. G., Baron-Cohen, S., & McEwen, B. S. (2011). Testosterone administration impairs cognitive empathy in women depending on second-to-fourth digit ratio. *Proceedings of the National Academy of Sciences of the United States of America*, *108 (8),* 3448-3452. (www.pnas.org/cgi/doi/10.1073/pnas. 1011891108)

van Wingen, G. A., van Broekhoven F., Verkes, R. J., Petersson, K. M., Bäckström, T., Buitelaar, J. K., & Fernández, G. (2008). Progesterone selectively increases amygdala reactivity in women. *Molecular Psychiatry*, *13*, 325–333. Doi:10.1038/sj.mp.4002030

van Wingen, G. A., Zylicz, S. A., Pieters, S., Mattern, C., Verkes, R. J., Buitelaar, J. K., & Fernández, G. (2009). Testosterone increases amygdala reactivity in middle-aged women to a young adulthood level. *Neuropsychopharmacology*, *34*, 539–547. Doi:10.1038/npp.2008.2

Velandia, M., Uvnäs-Moberg, K., & Nissen, E. (2011). Sex differences in newborn interaction with mother or father during skin-to-skin contact after Caesarian section. *Acta Paeditrica*, *101*, 360-367. Doi: 10.1111/j.1651-2227.2011.02523.x

Wager, T. D., & Ochsner, K. N. (2005). Sex differences in the emotional brain. *NeuroReport*, *16 (2),* 85-87. Doi: http://dx.doi.org/10.1097/00001756-200502080-00001

Weinberg, M. K., Tronick, E. Z., Cohn, J. F., & Olson, K. L. (1999). Gender differences in emotional expressivity and self-regulation during early infancy. *Developmental Psychology*, *35*, 175-188. Doi: 10.1037/0012-1649.35.1.175

Διαφυλικές διαφορές στη συνεργασία και την επικοινωνία με τα βρέφη

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Περίληψη

Ο σκοπός της παρούσας έρευνας ήταν η σύγκριση του *συγκινησιακού συντονισμού* και του *μη-ταιριάσματος* στις αυθόρμητες δυαδικές αλληλεπιδράσεις των κοριτσιών και των αγοριών με τις μητέρες τους κατά την πρώιμη βρεφική ηλικία. Οι αυθόρμητες δυαδικές αλληλεπιδράσεις έντεκα δυάδων βρέφους-μητέρας από την Κρήτη, Ελλάδα (έξι δυάδες με κορίτσια και πέντε δυάδες με αγόρια), βιντεοσκοπήθηκαν στο σπίτι των βρεφών από το δεύτερο έως τον έκτο μήνα της ζωής τους. Μέσω της μικρο-ανάλυσης διερευνήσαμε το *συντονισμό* και το *μη-ταίριασμα* των συγκινησιακών εκφράσεων προσώπου. Ο *συγκινησιακός συντονισμός* αξιολογήθηκε με βάση τέσσερις μετρήσεις: το *ταίριασμα* των συγκινησιακών εκφράσεων προσώπου, τη *συμπληρωματικότητα,* όταν ο ένας σύντροφος αποκρινόταν στον άλλο με *ευχαρίστηση* ή *ενδιαφέρον*, το *συγχρονισμό* στο ταίριασμα της συχνότητας των αλλαγών ή του ρυθμού των συγκινησιακών εκφράσεων και τέλος, την *εναρμόνιση,* όταν οι αλλαγές στη συγκινησιακή έκφραση των δυο συντρόφων ήταν προς την ίδια κατεύθυνση. Το *συγκινησιακό μη-ταίριασμα* κωδικοποιήθηκε, όταν δεν υπήρχε ενδιαφέρον για επικοινωνία εκ μέρους του ενός ή και των δύο συντρόφων. Επίσης, η κατεύθυνση, δηλαδή, ποιος αποκρίνεται πρώτος, μικρο-αναλύθηκε στο συγκινησιακό ταίριασμα και στο μη-ταίριασμα. Η παρούσα μελέτη παρέχει ενδείξεις *διαφοροποιήσεων* που συνοψίζονται στα εξής σημεία:

α) ο συγκινησιακός συντονισμός ήταν εντονότερος και πιο ακριβής στα κορίτσια, ενώ το συγκινησιακό μη-ταίριασμα ήταν εντονότερο και συχνότερο στα αγόρια. Ο συνδυασμός συγκινησιακού ταιριάσματος/συμπληρωματικότητας ήταν πιθανότερο να συμβεί στα κορίτσια, ενώ ο συνδυασμός συγκινησιακού ταιριάσματος/μη-ταιριάσματος και το διακοπτόμενο συγκινησιακό ταίριασμα ήταν πιο πιθανό να συμβούν στα αγόρια,

β) τα κορίτσια αποκρίθηκαν με συγκινησιακό ταίριασμα και μη-ταίριασμα στις συγκινησιακές εκφράσεις των μητέρων τους πιο συχνά από τα αγόρια,

γ) η συγκινησιακή σταθερότητα ήταν εντονότερη για τις εκφράσεις της ευχαρίστησης, του ενδιαφέροντος και του ουδέτερου συναισθήματος των κοριτσιών, ενώ το αντίστοιχο συνέβαινε για τις εκφράσεις του εξωτερικού ενδιαφέροντος και του αρνητικού συναισθήματος των αγοριών. Η συγκινησιακή σταθερότητα των μητέρων των αγοριών ήταν εντονότερη από εκείνη των μητέρων των κοριτσιών, και

δ) οι αναπτυξιακές καμπύλες του συγκινησιακού ταιριάσματος και του συγκινησιακού μη-ταιριάσματος ακολουθούν διαφορετικά πρότυπα στις ελεύθερες αλληλεπιδράσεις των κοριτσιών και των αγοριών με τη μητέρα κατά τη διάρκεια της παρούσας έρευνας.

Μέσα στο πλαίσιο της θεωρίας της Έμφυτης Διυποκειμενικότητας θεωρούμε ότι τα κορίτσια και τα αγόρια πιθανό να διαφοροποιούνται στον τρόπο συντονισμού των χρονικών προτύπων και των προτύπων μορφής και έντασης των συγκινησιακών εκφράσεων προκειμένου να φτάσουν στο συγχρονισμό των προθέσεων και των ενδιαφερόντων προς τη μητέρα τους. Τέτοιου είδους διαφυλικές διαφορές στην επικοινωνία πιθανόν να συμβάλουν στην κατανόηση της σημασίας της συμπληρωματικότητας των ρόλων των δυο φύλων που κάνουν εφικτή τόσο τη φροντίδα του βρεφικού νου όσο και τη μετάδοση της πολιτισμικής γνώσης.

Λέξεις κλειδιά*:* αλληλεπίδραση μητέρας-βρέφους, διαφυλικές διαφορές στη βρεφική ηλικία, συναισθηματικές εκφράσεις προσώπου, συναισθηματικός συντονισμός, συναισθηματικό ταίριασμα, συγχρονισμός, συμπληρωματικότητα, συναισθηματικό μη-ταίριασμα, Έμφυτη Διυποκειμενικότητα.