Infant and Child Development
Inf. Child Dev. **15**: 387–402 (2006)
Published online 2 June 2006 in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/icd.466

What do Mothers Attune to During Interactions With Their Infants?

Carl-Otto Jonsson[a,*] and David Clinton[b]
[a] *Department of Psychology, Stockholm University, Sweden*
[b] *Division of Psychiatry, Neurotec Department, Karolinska Institutet, Karolinska University Hospital-Huddinge, Sweden*

There has been considerable theoretical interest in the developmental importance of affect mirroring and attunement, but little empirical attention has been directed toward the topic. The present study systematically explored the sorts of infant behaviour that elicit affect attunement in mothers. Written descriptions of video-recorded sequences of interaction in 27 mother–infant dyads were used to examine 141 instances of affect attunement in samples from Sweden and the former Yugoslavia. Infants were aged between 2 and 12 months. Behaviour that elicited affect attunement from mothers was rated in terms of 10 behavioural themes, which were used to cluster episodes of affect attunement. Cluster analysis suggested that mothers attuned to six distinct forms of infant behaviour: pleasurable motoric behaviour, effect initiation, focusing, loss of balance, uncontrolled behaviour and displeasure. Incidents of affect attunement elicited by categorical affects comprised only 20% of the instances examined. Most importantly, affect attunement was often elicited by infant exploration and play in relation to the non-social world. Affect attunement may function to reinforce and regulate ongoing behaviour that is largely explorative in nature. How mothers respond to the infant's interaction with the external, non-social world may be more important for intrapsychic development than previously thought.

Key words: affect attunement; affect mirroring; infant development

INTRODUCTION

An important question concerning human development is how emotional experience becomes organized, conscious, linguistically encodable and sharable. In recent years there has been an increasing emphasis on integrating empirical studies of cognitive, linguistic and social development during infancy with psychodynamic and interpersonal theories in order to illuminate

*Correspondence to: Carl-Otto Jonsson, Burträskgatan 63, S-162 62 Vällingby, Sweden. E-mail: cojn@psychology.su.se

the developing infant's representations of internal feeling-states (Beebe, Lachman, & Jaffe, 1997; Feldman & Greenbaum, 1997; Fonagy, Gergely, Jurist, & Target, 2002; Gergely & Watson, 1996; Stern, Hofer, Haft, & Dore, 1985). A number of variously defined concepts have been put forward to illuminate important aspects of this developmental process. Fonagy and colleagues (2002) have, for example, placed considerable emphasis on the concept of affect mirroring. Earlier in the literature Stern and co-workers (1985) focused on what they termed 'affect attunement'. They define affect attunement as an interpersonal and communicative process whereby a caregiver signals that he/she shares a feeling-state of the infant. The construct is seen as encompassing three distinct stages of interaction: (a) the caregiver, usually the mother, identifies her infant's feeling-state through the infant's behaviour; (b) she conveys this same feeling back to the infant without using simple imitation; and (c) the infant comprehends the mother's response as referring to the original affective state. An example of the first two stages of affect attunement would be the mother who verbally expresses the infant's feeling of effort by exclaiming 'ohhh' when he strenuously stretches his arm towards a ball. According to Stern and co-workers, internal states that are not attuned to will remain private and become experienced as idiosyncratic. Such internal states may thereby not become sharable or linguistically encodable (Stern *et al*., 1985, p. 266).

Similar notions to affect attunement have been introduced by other researchers over the years. While Beebe, Feldstein, Jaffe, Mays, and Alson (1985) and Beebe *et al*. (1997) gave rather sketchy descriptions of the phenomenon, Fonagy and colleagues, along with Feldman and Greenbaum have been more elaborate. Fonagy, Steele, Moran, and Higgitt (1991) take up a position close to Stern's and argue that when the mother attunes she reflects on the infant's experience and re-presents it to the infant translated in a language of actions that is understandable for the child. While Stern points to the difference between simple imitation and affect attunement, Fonagy and colleagues draw attention to the importance of the mother's modification of what she re-presents to her infant. The mother's mirroring is marked, typically by producing an exaggerated version, signalling to the infant that she re-presents the infant's emotion, not her own. Recently, Fonagy *et al.* (2002) have presented a social biofeedback theory of parental affect mirroring that focuses on the way in which the infant's automatic emotion expression, along with the caregiver's consequent reactions, comes to be linked in the infant's mind through the detection of interpersonal contingencies that gradually become internalized. In such a way parental affect mirroring creates a base for higher order representations of the infant's experience.

A problem with much of the work on parental affect mirroring is that the concept has been only loosely defined, if at all. Much of the material on affect mirroring has been largely based on theoretical work that attempts to integrate empirical developmental psychology with psychodynamic constructs, or alternatively has been based on unsystematic observation. In contrast, Stern's notion of affect attunement is both specifically defined and has proved to be amenable to empirical research. Early studies reported that affect attunement develops from imitation around 8 months of age (Bretherton, 1990; Stern, 1985; Stern *et al*., 1985), although infants younger than 8 months were not studied. Our own work (Jonsson *et al*., 2001) suggests that single occurrences of affect attunement appear at two or three months of age, and that by 6 months of age affect attunement dominates over imitation

for the purpose of signalling shared feeling states. The emergence of affect attunement has also been linked to later developmental milestones. For example, Feldman and Greenbaum (1997) found that maternal affect attunement at 3 months predicted both symbolic play and internal state talk at two years. Although these studies underline the importance of affect attunement, it remains unclear what infant behaviours do in fact elicit attunement. Better knowledge of what mothers attune to might help us to better understand the function of affect attunement and its role in the development of mentalization.

Some initial steps have been taken in this direction, but they have not involved the systematic analysis of mother–infant dyads. In their early work, Stern and colleagues (1985) attempted to elucidate the function of affect attunement by asking both experimenters and mothers what the mother intended to accomplish by her attunement behaviour. The most common attributions were 'to commune', 'to respond' and 'to tune' (42%, 39% and 16%, respectively, of experimenters' and mothers' combined attributions). Fonagy *et al.* (2002), however, maintain that affect attunement cannot have the function of interpersonal communion and internal state sharing for these young infants since they have not yet become sensitized to their own internal states of categorical affects (2002, p. 185). Although Fonagy and co-workers do not study the concept empirically, they put forward what is essentially a learning theory and propose that mothers selectively reinforce affective or voluntary acts made by infants that the mothers would like to see continued or repeated in the future by momentarily attuning to acts performed by their infants. As such, they tend to emphasize a sensitizing and representation-building function to affect attunement, rather than an intersubjective function focusing on the sharing of internal states.

The present study attempted to extend our previous work on the emergence of affect attunement and imitation during the first year of life (Jonsson *et al.*, 2001) and aimed to explore the sorts of infant behaviour mothers were responding to during episodes of affect attunement. This was done using descriptions of video-recorded sequences of affect attunement and subjecting them to cluster analysis (Everitt, Landau, Leese, 2001). Cluster analysis is a statistical technique that allows a researcher to explore underlying patterns and groupings of individuals, behaviours, etc. It allows a data set to be divided into groups (clusters) of observations that are similar to each other. In the present study ratings of descriptions of affect attunements were clustered, which allowed for the identification of distinct themes in the behaviours to which mothers were attuning. In order to achieve a culturally diverse sample of satisfactory size, two samples of mother–infant dyads were used from two distinct European ethnic groups (Sweden and the former Yugoslavia). A relatively broad range of ages was used in the study (2–12 months of age). This was done since the aim of the study was to examine general themes pertaining to behaviours that elicit affect attunement, and since our previous work found this to be a relevant age interval (i.e. affect attunement was being exhibited from 2 months of age, and extensively so by 12 months). Due to issues of sample size, cluster analysis was not conducted separately for distinct age groups. In order to explore age-related developmental issues the sample was retrospectively divided into those under 9 months and those over 9 months of age. A cut-off point of 9 months was used in order to have two groups that were likely to differ in terms of secondary intersubjectivity (Trevarthen, 1998, Trevarthen & Hubley, 1978).

METHODS

Participants

Two samples of mother–infant dyads from Sweden (N=10) and the former Yugoslavia (N=17) were used in the present study. Infants in the Swedish sample were 3–12 months old (M=7.6 months, S.D.=3.2 months), and comprised 6 boys and 4 girls. Nursery staff selected infants from intact nuclear Swedish-speaking families with no known emotional trauma or severe separation; mother–infant interaction was judged by nursery staff to be normal. Infants in the Yugoslavian sample were 2–12 months old, (M=7.2 months, S.D.=3.1 months), and comprised 10 boys and 7 girls. Families were recruited with the assistance of paediatricians working at child welfare centres in Belgrade, and represented intact nuclear Serbo-Croatian-speaking families without known occurrences of emotional trauma or severe separation. Mothers in both samples were of similar age (M=31.3 years, S.D.=4.7 years), socio-economic status (mostly middle class occupations) and education (secondary or higher). Both samples of mothers were also currently on maternity leave, and there were no known incidents of pre- or post- partum depression.

Measures

Ratings of affect attunement

Affect attunement was measured using the Affect Attunement Protocol (AAP) developed by Haft (1989) in collaboration with Stern. The AAP is the only empirically tested measure of affect attunement, and is used with video-recorded sequences of dyadic interaction. Video recordings are analysed in a naturalistic manner by examining short sequences of mother–infant interactions in their entirety, rather than frame by frame. Ratings are made of the intensity, rhythm, shape, and duration of both the mother's and the infant's behaviour. Reactions of mother and infant are compared, and the degree of similarity in their reactions is assessed by the rater on three-point scales; the modalities of the infant's and mother's behaviour are also noted and compared in a similar way. Behaviour is rated as an incidence of affect attunement when the infant's initial behaviour is matched by the mother's response in one or more dimensions (i.e. intensity, rhythm, shape, or duration), and either: (a) the mother's modality for expressing the behaviour is completely changed compared to the infant's initial modality, or (b) another modality is added, or (c) the mother expresses a clear affective emphasis. Another condition is that the mother should in no way be attempting to alter the infant's behaviour. Each episode of affect attunement was also given a short written description, e.g. 'Child crawls to mother, rises to his feet, loses balance, tumbles; mother says Ooops'. More examples of written descriptions of affect attunement are given in the results section below. The descriptions were made using common, everyday language and avoiding theoretical jargon. A total of 141 descriptions of affect attunement were identified using the AAP, and these descriptions were used for the rating of behavioural themes. The behaviours measured by the AAP that mother attuned to were typically very short, lasting one or two seconds.

Ratings of behavioural themes

Although the AAP identifies instances of affect attunement, it does not systematically identify or rate the sorts of infant behaviour that the mother is attuning to. A new measure was therefore developed for this purpose and used in conjunction with the AAP. Termed Behavioural Themes in Affect Attunement (BeTA), the instrument was used to rate distinct affective features or themes in infants' behavioural displays. Development of BeTA was carried out by the senior author. He examined the Swedish video recordings and AAP protocols used in the study and initially made short, simple notes of the infant behaviour that the mothers responded to with affect attunement. The aim was to identify simple themes, phrased in non-theoretical language, that were both natural and unsophisticated, and that characterized the infants' behaviour in a recognizable way. Although such a list of behavioural themes can be argued to be primarily heuristic, it was reasoned that these simple characterizations could subsequently be clustered in order to reveal forms of behaviour that were more complex and theoretically meaningful. An initial list of behavioural themes was discussed with other researchers in the field in order to identify and correct insufficiencies and ambiguities, as well as to reduce the number of descriptive categories, resulting in a final list of eleven themes. Using the Swedish sample, a manual was developed to rate the presence of these themes on four-point graded scales (0 = not present, 1 = slightly present, 2 = moderately present, 3 = highly present), and this was subsequently used by the senior author and an independent psychologist to rate the Yugoslavian sample and examine the *inter-rater reliability of the BeTA*. For the purposes of the present study one of these eleven themes was excluded from subsequent analysis (Positive emotion) due to low inter-rater reliability (r =0.08). Discrepancies in the rating of this particular theme were due to ambiguity in the manual, which did not specify whether ratings of positive emotion should be based entirely on overt behaviour, as the intention was when the scale was constructed initially, or whether they should also include inferences about the presence of unexpressed positive emotion. The remaining ten behavioural themes that were used in the present study were (including inter-rater r and Spearman–Brown estimated reliability of combined ratings):

- *Loss of control over actions* (r = 0.87, *S–B estimated* = 0.93), e.g. inadvertently dropping an object.
- *Sudden or unexpected behaviour* (r = 0.92, *S–B estimated* = 0.96), e.g. sneezing.
- *Falling* (r = 0.89, *S–B estimated* = 0.94), e.g. the baby sits on the floor, tilts backward.
- *Risk behaviour* (r = 0.76, *S–B estimated* = 0.87), e.g. engaging in potentially harmful behaviour.
- *Motor effort in actions and movements* (r = 0.63, *S–B estimated* = 0.77), e.g. lifting one object with another.
- *Attention and curiosity* (r = 0.66, *S–B estimated* = 0.80), e.g. focused gazing at an object or person.
- *Affect* (r = 0.70, *S-B estimated* = 0.82), e.g. expressions of any type of emotion.
- *Negative emotion* (r = 0.72, *S–B estimated* = 0.84), e.g. expressions of sadness.
- *Striving* (r = 0.65, *S–B estimated* = 0.79), e.g. stretching towards an object from an uncomfortable distance.
- *Effective action* (r = 0.46, *S–B estimated* = 0.63), e.g. throwing an object.

Procedure

Video recordings of 15 minutes of face-to-face interaction were made in the homes of participating dyads. Mothers had not been given instructions about what to do, but the general setting made playful interaction with the infant a natural choice. From about 4 months of age a selection of the infants' toys were close at hand. Dyads were filmed by native speakers of Swedish or Serbo-Croatian who adopted a passive stance while filming and who remained in the room while filming. Identification of affect attunement along with descriptions of these episodes were made independently from the video recordings by two pairs of psychologists. The entire 15-minute video sequence of each dyad was used. The present authors were not involved in the identification of episodes of affect attunement or making descriptions of these episodes. In the Swedish sample, subsequent BeTA ratings were made on a consensus basis to aid the construction of a rating manual, whereas in the Yugoslavian sample ratings were made independently for the purpose of testing inter-rater reliability. The senior author was always one of the BeTA raters. BeTA ratings were used to cluster episodes of affect attunement. The study followed appropriate professional and ethical guidelines, and informed consent was obtained from the parents involved.

Data analysis

Cluster analysis was used to group 141 instances of affect attunement on the ten BeTA behavioural themes. Prior to computation of cluster analysis, BeTA ratings were standardized, and standard scores were used for subsequent cluster analyses. Cluster analysis was conducted in three steps using SLEIPNER (Bergman & El-Khouri, 1998), a statistical package for person-based analysis, focusing specifically on cluster analysis. These three steps involved an initial identification of outliers, subsequent use of techniques for hierarchical cluster analysis, and finally non-hierarchical clustering techniques to optimize results. Following cluster analysis, between-group comparisons were performed on age and ethnic group for resultant clusters.

RESULTS

Identification of outliers

In the first step, residual analysis was conducted to identify outliers (i.e. incidents of affect attunement that were clearly deviant and unlike other incidents of affect attunement were identified). This is an important initial step in cluster analysis, since it allows for the exclusion of statistically eccentric cases that may obscure more normative patterns in the data. Residual analysis resulted in the identification of five outliers that were discarded from further analyses. These outlying episodes of affect attunement constituted a diverse group. Three of the incidents comprised uncommon behaviours, and the remaining two included very complex interactions.

Hierarchical cluster analysis

In the second step, hierarchical cluster analysis was computed using Ward's method. Hierarchical techniques proceed from an initial number of groups

(clusters) equal to the number of observations in the data set. In the present study this involved starting with an initial number of clusters equal to the 141 observations of affect attunement minus the 5 outliers identified in the preceding step. Each observation was, therefore, initially considered an observation in its own right. From this array of 136 instances of affect attunement, the procedure then used an iterative agglomeration algorithm to identify the two instances of affect attunement that were most similar to each other in terms of the BeTA ratings, and combined these observations into a new cluster, resulting in 135 clusters. At each subsequent iteration the two observations that were most similar were combined. The technique proceeded in a hierarchical manner until only 2 clusters were left. In the present study, the resultant pattern of agglomeration was heuristically most interesting from 10 clusters down to 2. Determination of the optimal number of clusters was based on the interpretability of specific cluster solutions, which suggested that the optimal number of clusters was six.

In order to control for possible bias in BeTA ratings (the senior author was always one of the BeTA raters) separate hierarchical cluster analyses were conducted in the above manner on the ratings of the senior author and the ratings of the independent psychologist. Although the resultant two 6-cluster solutions were somewhat less distinct, which is not surprising since each sample was more restricted, they were very similar to each other and tended to mirror the pattern of results for the entire sample. This supported both the reliability of the BeTA ratings and the use of the 6-cluster hierarchical solution for subsequent non-hierarchical cluster analysis.

Non-hierarchical cluster analysis

In the third step, non-hierarchical cluster analysis using the relocation method was utilized to arrive at an optimal classification. This final step started from the previous 6-cluster solution using Ward's hierarchical method. Using an iterative algorithm each case was examined in relation to the six cluster centroids in order to arrive at the optimal allocation of cases. Conceptually, this step is akin to rotation in factor analysis. When relocation analysis is used in cluster analysis it tends to yield more homogeneous and conceptually distinct clusters compared to hierarchical methods. Results of this procedure, which can be considered as the final cluster results, are presented in Table 1. The table gives the number of incidents of affect attunement in each cluster, along with mean *z*-scores on BeTA ratings of behavioural themes for the six clusters.

Description of clusters and examples of incidents of affect attunement

Cluster 1: Pleasurable motoric behaviour (46 incidents of affect attunement, age: M = 8.4 months, S.D. = 2.8). This was the largest and most general of the six clusters. Its profile was close to the mean on all BeTA subscales, with only a few exceptions. Compared to other clusters there was a tendency toward relatively higher mean values on *Motor effort in actions and movements* as well as *Affect*. On the other subscales the cluster was characterized by low negative scores. In this cluster mothers' attunements appeared to be elicited by behaviour that combined positive affect with general motoric activity. The infant's physical activity did not appear to be related to striving behaviour or the result of some sort of negative

Table 1. Cluster profiles on ratings of affect attunement using AAP

Cluster label	No. of incidents	Mean z-score AAP subscales									
		Loss of control over actions	Sudden or unexpected behaviour	Falling	Risk behaviour	Motor effort in actions/ movements	Attention/ curiosity	Affect	Negative emotion	Striving	Effective behaviour
Pleasurable motoric behaviour	46	−0.5	−0.6	−0.4	−0.4	0.2	−0.3	0.4	−0.3	−0.3	−0.2
Effect initiation	29	−0.6	−0.5	−0.5	−0.5	0.8	−0.1	0.1	−0.3	1.6	1.6
Focusing	19	−0.6	−0.6	−0.5	−0.5	−0.7	2.1	−0.5	−0.3	−0.3	−0.6
Loss of balance	19	1.7	1.7	2.3	2.0	−0.5	−0.6	−0.7	−0.2	−0.7	−0.7
Uncontrolled behaviour	16	1.5	1.5	−0.2	−0.1	−0.7	−0.6	−0.6	0	−0.7	−0.5
Displeasure	7	−0.6	−0.6	−0.4	−0.4	−0.5	−0.4	1.5	3.7	−0.6	−0.4

situation such as loss of control over actions or reactions to sudden occurrences. Closer inspection of Cluster 1 revealed that it comprised three types of mostly pleasurable motoric behaviour: expressions of excitement and happiness (20 incidents, that were characterized by categorical affects), strong motor efforts with no signs of excitement or other emotions (10 incidents), and rhythmic movements that mother responded to by marking the rhythm (7 incidents). Examples of incidents of affect attunement within this cluster were:

- Mother and Stefan (5 months) are playing together. He is lying in his bed. Mother stands there, bends down over him and turns him on his face. Stefan opens his mouth, wondering and full of joy. Mother makes an upward movement of her head and her tone of voice is joyful (expressions of excitement and happiness).
- Niclas (4 months) lies on his belly and makes an effort to lift up his head. It seems very trying, and he makes a sound 'Aeh'. Mother reacts by wagging her head (strong motor efforts with no signs of excitement or other emotions).
- Anna (7 months) strikes mother's upper arm several times with her hand, and mother responds verbally in the same rhythm with 'clap, clap, clap' (rhythmic movements).

Cluster 2: Effect initiation (29 incidents of affect attunement, age: M = 9.9 months, S.D. = 2.0). This cluster comprised incidents with high scores on *Motor effort in actions and movements, Striving* and *Effective behaviour*. In these episodes mothers appeared to be responding to some sort of intentional behaviour, a behaviour where there appears to be some expectation of effect. Typically mothers used an expression of emotion to underline the character and effect of the infant's action. Examples of incidents of affect attunement within this cluster were:

- Niclas (4 months) kicks with his legs. Mother says 'Uhuhuhuh' with the same intensity, rhythm and duration.
- Niels (12 months) stands in his walking chair. Mother throws a ball to him several times. When he catches the ball, he presses it with delight towards his mouth. Mother says with feeling in a singing voice 'Mmmmmm.'

Cluster 3: Focusing (19 incidents of affect attunement, age: M = 7.7 months, S.D. = 2.8). This cluster was characterized by high values on the *Attention and curiosity* subscale. Mothers' affect attunement appeared to be elicited by the infant's focusing of attention on an animate or inanimate object. Typically mothers responded by sharing and emphasizing a sense of curiosity and wonder. Examples of incidents of affect attunement within this cluster were:

- Mother notices that Natalia (3 months) turns away from their mutual interaction. Natalia looks at the photographer and the camera. Mother says in a lowered voice: 'Is somebody there?'
- Mother sits at the bedside of Gustav (9 months) holding his hands. He is standing, gazing at an object on the table nearby. Mother asks in a wondering voice: 'What is it?'

Cluster 4: Loss of balance (19 incidents of affect attunement, age: M = 8.2 months, S.D. = 2.5). This cluster was characterized by incidents with high scores on *Loss of*

control over actions, Sudden or unexpected behaviour, Falling, and *Risk behaviour*. In most of the instances affect attunement was elicited by some sort of loss of balance. The mother's voice often stressed the character of the incident. Examples of incidents of affect attunement within this cluster were:

- Mother holds Nina (2 months) in front of her. Nina's head drops to one side, and mother responds by saying 'Opoo.'
- Balsa (10 months) tumbles on her behind. Mother says ''Opala'' with the intensity of the fall mirrored in her voice.

Cluster 5: Uncontrolled behaviour (16 incidents of affect attunement, age: M = 6.7 months, S.D. = 3.3). This cluster was primarily comprised of incidents with high scores on *Loss of control over actions* and *Sudden or unexpected behaviour*. Mothers appeared to be responding to three types of behaviour: (i) the infant sneezes or burps, and mother responds with one or two words expressing the suddenness of what happened; (ii) the infant happens to drop an object or makes something happen by chance, and mother points out the character of the incident; (iii) the infant is close to falling, but there is minimal or no risk that the infant will be hurt, and mother marks the incident with one or two words but without affect. Examples of incidents of affect attunement within this cluster were:

- Tara (3 months) breaks wind. Mother says 'Oooo'.
- Milos (11 months) drops a toy, and it falls behind him. Mother says with an expression of sadness: 'Oooo, it fell'.
- Nikola (6 months) sits while mother holds his hand. The infant starts to fall forward, while mother says 'Up' in a neutral tone of voice.

Cluster 6: Displeasure (7 incidents of affect attunement, age: M = 6.5 months, S.D. = 2.8). This cluster was the smallest of the six, and comprised incidents of affect attunement with high scores on *Affect* and *Negative emotion*. Here mothers appeared to predominantly be reacting to expressions of distress. Mothers' responses were often characterized by simple sounds, using a tone of voice that was consonant with the infant's distress. All episodes of behaviour that elicited affect attunement responses in this cluster were characterized by categorical affects. Examples of incidents of affect attunement within this cluster were:

- Nina (2 months) is having her bib changed by mother. Nina appears to experience this as a trying situation, and says 'Aaa' in a stressed voice. Mother replies by saying 'Uh, uh, uh' at the same time as Nina grimaces with her mouth.
- Sara (7 months) sits on her mother's lap and throws herself backwards with an expression of displeasure. Mother says 'Aaa' in a low voice.

Group comparisons

In order to investigate whether there were systematic differences in the distribution of clusters between different age and ethnic groups, comparisons were made using the chi-square test. For age comparisons, the sample was divided into infants under 9 months and those over 9 months of age. This particular cut-off point was chosen in order to have two groups that were likely to differ in terms of secondary intersubjectivity. This resulted in 17 cases in the

Table 2. Group comparisons in frequencies of incidents of affect attunement (N=136) in the six clusters

	Age		Sample	
Cluster label	< 9 months	> 9 months	Sweden	Yugoslavia
Pleasurable motoric behaviour	21	25	20	26
Effect initiation	9	20	16	13
Focusing	10	9	9	10
Loss of balance	10	9	7	12
Uncontrolled behaviour	10	6	8	8
Displeasure	5	2	1	6

younger group, and 10 in the older one. For ethnic comparisons, the sample was divided into those families living in Sweden and families from the former Yugoslavia. Results are presented in Table 2.

Neither the overall chi-square distribution of clusters of incidents of affect attunement nor the distribution within selected clusters differed significantly for any comparison. Overall Phi for age was 0.22 ($p = 0.25$) and for ethnic group 0.18 ($p = 0.46$). However, some interesting non-significant tendencies were observed in the data concerning age. This pertained to *Effect initiation, Uncontrolled behaviour,* and *Displeasure*. Instances of affect attunement that were elicited by *Effect initiation* tended to be more typical of older infants, while instances that were elicited by *Uncontrolled behaviour* and *Displeasure* tended to be more typical of the younger infants.

DISCUSSION

The aim of the present study was to explore the sorts of infant behaviour to which mothers respond during episodes of affect attunement. To this end cluster analysis was used to group instances of affect attunement rated in terms of ten behavioural themes. We found six clusters of infant behaviour that elicited attunement responses from mothers. Four of these clusters were fairly distinct and homogeneous, *Displeasure, Focusing, Loss of balance* and *Effect initiation.* The two remaining clusters were more heterogeneous. The largest cluster, *Pleasurable motoric behaviour,* comprised behaviours expressing excitement and happiness, together with strong motor efforts, or rhythmic movements. *Uncontrolled behaviour* was also relatively heterogeneous, and tended to encompass a range of behaviours in which the infant did not have control over bodily functions or objects, e.g. sneezing, burping, almost falling or incidentally dropping objects.

Attunements tended to be elicited by quite diverse sorts of behaviour, which in turn suggests that affect attunement may have multiple specific functions. The largest cluster was *Pleasurable motoric behaviour,* where affect attunement was elicited by behaviour that combined positive affect with physical activity. This physical activity appeared to be general in nature, and not related to striving behaviour or the experience of some sort of negative situation such as loss of control over actions or sudden occurrences. In the *Pleasurable motoric behaviour* cluster the infant's behaviour can be interpreted as eliciting responses in mothers that reinforced a positive experience of the infant's exploratory apparatus, i.e. the body, which the infant uses for examining the world.

The *Focusing* cluster was characterized by quietness and stillness, and could be related to attention. By responding to and sharing the infant's underlying curiosity, the mother may help the infant to focus and maintain attention. A large body of evidence suggests that parents' interactions with their infants need be well controlled and adjusted to the infant's level of arousal for the interactions to have a positive effect on attention and exploration (Emde, 1992; Field, 1981; Lawson, Parrinello, & Ruff, 1992; Parrinello & Ruff, 1988; Rose, Futterweit, & Jankowski, 1999; Ruff & Rothbart,1996). In the *Focusing* cluster mothers' responses may be acting to maintain arousal at an optimal level, fuelling further exploration of the surrounding world.

In the *Effect initiation* cluster affect attunement was often being elicited by effortful and striving behaviours that were toward the limits of the infant's abilities. In these episodes of affect attunement the infant's behaviour was met by responses of similar intensity from the mother. As such, mothers appeared to signal an understanding of the infant's frustration, while at the same time encouraging the infant to proceed with the efforts to strive further and succeed. In these instances affect attunement may be acting to both contain frustration and actively stimulate exploration and interpersonal interaction. Moreover, by underlining the effects of the infant's behaviour, the mother can be seen as drawing attention to contingencies, making it clearer how the world works. Such a contingency function can even be seen in the *Uncontrolled behaviour* cluster, where the infant's behaviour was simpler and less complex than in the *Effect initiation* cluster, but where mothers often responded by emphasizing the effects of the infant's actions.

The *Displeasure* cluster, which was the smallest of the six, involved instances of affect attunement that were elicited by marked negative emotion. Similarly, the *Loss of balance* cluster comprised episodes that were elicited by behaviour that had an alarming or frustrating character. In these clusters affect attunement may be acting to directly contain and differentiate affective experience, ensuring that the infant is not overwhelmed by the affective content associated with a given situation. Feldman and Greenbaum (1997) have contended that the mother, when attuning, enables her infant to experience positive arousal that does not have a disorganizing effect. Such a possible function would also be in line with ideas put forth by Fonagy and colleagues (1991) who emphasise the containing function of affect mirroring. Furthermore, in the *Displeasure* and *Loss of balance* clusters, affect attunement can be seen to function as a means of matching the infant's experience, in loss of balance ensuring that the infant becomes aware of danger, but is not overwhelmed by affect, which could inhibit adequate action.

Some non-significant tendencies toward age-related differences between clusters were noted. Instances of affect attunement that were elicited by *Effect initiation* were seen more often in older infants, while instances that were elicited by *Uncontrolled behaviour* and *Displeasure* tended to be typical of younger infants. Although potentially interesting in terms of age-related change in affect attunement, these tendencies do not provide a basis for making conclusions about such questions. They do, however, suggest that the question of age-related differences in affect attunement may be a fruitful one for future research. Likewise, a more definite answer to the question of cultural differences in affect attunement will also have to await future research. Although the lack of significant differences in the distribution of clusters between samples from Sweden and the former Yugoslavia lend support to the cross-cultural generalizability of our findings, the small samples concerned make conclusions concerning cultural differences tentative. In future, it will be important to

conduct longitudinal research using larger samples from other countries to more systematically evaluate the influence of age and culture on affect attunement.

Affect attunement and categorical affects

It is striking that episodes of affect attunement that were elicited by distinct categorical affects were relatively rare. Categorical affects appeared in the *Displeasure* cluster, but this cluster was small, comprising only 7 incidents of affect attunement. In *Pleasurable motoric behaviour* 20 of the 46 instances of affect attunement involved categorical affects (i.e. expressions of excitement and/or happiness). Even when there were vocal and mimic expressions of happiness or excitement in the *Pleasurable motoric behaviour* cluster, these expressions tended to be mixed with distinct motoric behaviour (e.g. the infant pleasurably striking the mother's arm, shaking a rattle with delight, or rocking back and forth joyfully). Here it should be borne in mind that the focus of our study concerned infant behaviour that was eliciting affect attunement responses in mothers, and not the infant's expression of affect *per se*. There was, for example, a higher frequency of positive affect expression among infants than is apparent in our clusters, but much of this behaviour simply did not tend to elicit affect attunement responses from mothers, and is therefore not represented in the clusters. Although, as noted in the Methods section, positive affect could not be reliably rated when the scale for Positive emotion was used to code behavioural themes due to ambiguities in the coding manual, there were few difficulties in identifying such emotions when the clustering had been performed.

Taken as a whole, incidents of affect attunement that were elicited by categorical affects comprised only 20% of the 136 instances examined. Eighty percent of mothers' affect attunement was instead being elicited by infant behaviour that involved experiences of exploration, intentional movements, or efforts to control either the body or the physical world. Stern's (1985) contention that most affect attunements occur in relation to non-categorical affects, is therefore supported by our data, whereas the ideas put forth by Fonagy *et al*. (2002, p. 185) that the affects in affect attunement are primarily categorical are not supported. Although our results do lend support to Stern's ideas about the affects involved in affect attunement, it should be pointed out that his conception of non-categorical affects, which he terms *vitality affects*, has serious weaknesses, being both conceptually broad and vague.

Theoretical implications

Our findings cast light on the characteristics of affects that elicit affect attunement, and may have important implications for theories of intra-psychic development, as they point to the infant's early engagement in the physical world. Theoretically and clinically influential theories, such as that of Mahler, Pine, and Bergman (1975) attach little importance to exploration of the physical world for the infant's emotional development. When Mahler and colleagues discussed exploration of the physical, non-social world, they saw it as part of the intra-psychic process of separation and individuation. In their timetable, mother remains the primary focus of exploration well into the second year of life. This view is also shared in more recent writing within the Mahler tradition (e.g. Edward, Ruskin, Ruskin, Turrini, 1991). Given such a perspective, it is natural that the Mahler tradition has not considered that overcoming failures or

frustrations in exploration and play is important for intra-psychic development. Even attachment theory pays relatively little interest to mothers' behaviour when children explore, despite the fact that the Strange Situation (Ainsworth, Blehar, Waters, & Wall, 1978) was developed to examine infant exploration in the mother's presence and absence, and exploration was used as one of the significant markers of the securely attached child. According to Bowlby (1988) becoming anxious or alarmed, or becoming tired or uneasy are situations that can lead to the cessation of children's exploration and play, stimulating them to seek proximity to the mother. Yet the frustration associated with exploration and play in and of itself is not mentioned as contributing to the infant's need to seek proximity. Trevarthen and Aitken (1994), however, clearly differentiate between the parent's attachment behaviour that focuses on the child's need of protection, and the parent's close sharing of affects when the child is exploring the physical world.

Our results suggest that how mothers respond to the infant's interaction with the external, non-social world may be more important for intra-psychic development than previously thought. Empirical work by other researchers also emphasizes how the infant turns toward the outside world by the first half year of life. Lyons-Ruth and Zeanah (1993) found that infants in the second half of the first year increasingly direct their attention toward the environment. Bornstein and colleagues (Bornstein, Maital & Tal, 1997; Bornstein *et al*., 1992) found that by 5 months, infants in the United States, Japan, France, and Israel, attend more to the environment than to their mothers.

Seen in a wider theoretical context, our findings raise the possibility that affect attunement, attachment and exploration may be intrinsically linked. Not only may secure attachment be a prerequisite for exploration and engaging in the behaviours that naturally tend to elicit affect attunement, but affect attunement itself may function as a means for the infant to monitor attachment, and gauge the emotional availability of the mother. In this respect, affect attunement may function as a bridge between the infant's emerging objective knowledge of the external world and his or her subjective experience of the world and self. By providing an on-going, non-intrusive, emotional commentary that provides a means of making sense of the infant's experiences, the mother may aid the development of what might be termed the agency of the self, an ability to move between subjective experience of self and objective experience of both the interpersonal and physical worlds. This on-going, non-intrusive, emotional commentary by the mother may have both verbal and non-verbal components. In all the episodes of affect attunement in the present study, there was some aspect of verbalization on the part of the mother, even if the infant's reactions could be non-verbal. For the most part, the mothers' verbalizations were non-linguistic, i.e. utterances without the use of words proper. They tended to be direct expressions of affects or rhythms combined with non-verbal reactions. In this respect it is interesting that exploratory work suggests that affect attunement becomes less frequent from about 18 months of age, at a time when verbal communication comes increasingly to dominate interpersonal exchanges (Karlsson & Nydahl, 1994; Möller, 1999).

Although the present study casts preliminary empirical light on the behaviours that elicit affect attunement, much work remains to be done. One of the most important areas to explore will be the question of age-related changes in behaviour that elicits affect attunement. Future studies would benefit from larger samples and longitudinal designs that would allow for more systematic comparisons of age groups. In such studies separate cluster analyses could be

conducted within specified age ranges. Another important area to examine will be situational aspects of affect attunement. In the present study mother–infant dyads were studied in a naturalistic setting that lent itself to playful interaction. Future research could focus more explicitly on a wider range of situations, such as feeding, bathing and diaper changing, all of which may have different affective components than general playful interaction. Although ideas about affect attunement have been applied in the clinical literature, there has been no systematic empirical investigation of affect attunement among samples of infants with identifiable psychopathology or among samples at risk for developing such pathology. This will be another important area for research, along with closer examination of the quality of the mother's responses during episodes of affect attunement. How mothers respond during affect attunement could be studied using, for example, the notion of 'markedness' developed by Fonagy and co-workers (2002). Since most work within the field has focused on mothers and their infants, there is also a need to examine affect attunement in relation to other caregivers, such as fathers and siblings. Our work underlines the importance of conducting systematic research in order to better understand the emergence of the mentalization of affect, and the potentially deviant pathways this development can take. To this end, the notion of affect attunement will be theoretically, clinically and, most especially, empirically relevant.

REFERENCES

Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment*. Hillsdale, NJ: Lawrence Erlbaum.

Beebe, B., Feldstein, S., Jaffe, J., Mays, K., & Alson, D. (1985). Interpersonal timing: The application of an adult dialogue model to mother–infant vocal and kinesic interactions. In T. M. Field, & N. A. Fox (Eds.), *Social perception in infants* (pp. 217–247). Norwood NJ: Ablex.

Beebe, B., Lachman, F., & Jaffe, J. (1997). Mother–infant interaction structures and presymbolic self- and object representations. *Psychoanalytic Dialogues*, *7*, 133–182.

Bergman, L., & El-Khouri, B. M. (1998). *SLEIPNER: a statistical package for pattern-oriented analysis*. Department of Psychology, Stockholm University.

Bornstein, M. H., Maital, S. L., & Tal J. (1997). Contexts of collaboration in caregiving: Infant interactions with Israeli kibbutz mothers and caregivers. *Early Child Development and Care*, *135*, 145–171.

Bornstein, M. H., Tamis-LeMonda, C. S., Tal, J., & Ludemann, P., Toda, S., Rahn, C. W., Pêceux, M.-G., Azuma, H., & Vardi, D. (1992). Maternal responsiveness to infants in three societies: The United States, France, and Japan. *Child Development*, *63*, 808–821.

Bowlby, J. (1988). *A Secure Base.* London: Routledge.

Bretherton, I. (1990). Open communication and internal working models: Their role in the development of attachment relationships. In R. Thompson (Ed.), *Nebraska symposion on motivation 1988* (pp. 57–113). Lincoln: University of Nebraska Press.

Edward, J., Ruskin, N., & Turrini, P. (1991). Sep*aration / individuation. Theory and application*, (2nd Edn.). New York: Gardner Press.

Emde, R. N. (1992). Positive emotions for psychoanalytic theory: Surprises from infancy research and new directions. In T. Shapiro, & R. N. Emde (Eds.), *Affect: psychoanalytic perspectives* (pp. 5–45). Madison Connecticut: International Universities Press.

Everitt, B. S., Landau, S., & Leese, M. (2001). *Cluster analysis*, (4th ed.). London: Arnold.

Feldman, R., Greenbaum, C. W. (1997). Affect regulation and synchrony in mother-infant play as precursors to the development of symbolic competence. *Infant Mental Health Journal*, *18*, 4–23.

Field, T. M. (1981). Infant arousal and affect during early interactions. *Advances in Infancy Research*, *1*, 57–100.

Fonagy, P., Steele, M., Steele, H., & Moran, G. S., Higgitt, A. C. (1991). The capacity for understanding mental states: The reflective self in parent and child and its significance for security of attachment. *Infant Mental Health Journal*, *12*, 201–218.
Fonagy, P., Gergely, G., Jurist, E., Target, M. (2002). *Affect regulation, mentalization, and the development of the self*. New York: Other Press.
Gergely, G., Watson, J. S. (1996). The social biofeedback theory of parental affect-mirroring. *International Journal of Psycho-Analysis*, *77*, 1181–1212.
Haft, W. L. (1989). *Affect attunement and maternal attachment: An observational study of the intergenerational transmission of mothers' internal representations of attachment*. Ph.D. thesis, City University of New York.
Jonsson, C.-O., Clinton, D., Fahrman, M., Mazzaglia, G., Novak, S., & Sörhus, K. (2001). How do mothers signal shared feeling-states to their infants? An investigation of affect attunement and imitation during the first year of life. *Scandinavian Journal of Psychology*, *42*, 377–381.
Karlsson, T., & Nydahl, J. (1994). *En explorative studie av förekomst av affect attunement, imitation och kommentarer under det andra levnadsåret (An exploratory study of affect attunement, imitation, and comments during the second year of life.)*. Report, Department of Psychology, Stockholm University.
Lawson, K. R., Parrinello, R., & Ruff, H. A. (1992). Maternal behaviour and infant attention. *Infant Behaviour and Development*, *15*, 209–229.
Lyons-Ruth, K., & Zeanah Jr., C. H. (1993). The family context of infant mental health: I. Affective development in the primary caregiving relationship. In C. H. Zeanah Jr. (Ed.), *Handbook of infant mental health* (pp. 14–37). New York: Guilford Press.
Mahler, M. S., Pine, F., & Bergman, A. (1975). *The psychological birth of the human infant*. London: Hutchinson.
Möller, M. (1999). *Mammors lek med sina små barn (Mothers playing with their small children.)*. Report, Department of Psychology, Stockholm University.
Parrinello, R. M., & Ruff, H. A. (1988). The influence of adult intervention on infants' level of attention. *Child Development*, *59*, 1125–1135.
Rose, S. A., Futterweit, L. R., & Jankowski, J. J. (1999). The relation of affect to attention and learning in infancy. *Child Development*, *70*, 549–559.
Ruff, H. A., Rothbart, M. K. (1996). *Attention in early development*. New York: Oxford University Press.
Stern, D. N. (1985). *The Interpersonal World of the infant*. New York: Basic Books.
Stern, D. N., Hofer, L., Haft, W., & Dore, J. (1985). Affect attunement: The sharing of feeling states between mother and infant by means of inter-modal fluency. In T. Field, & N. Fox (Eds.), *Social perception in infants* (pp. 249–268). Norwood NJ: Alex.
Trevarthen, C. (1998). The concept and foundations of infant intersubjectivity. In S. Bråten (Ed.), *Intersubjective communication and emotion in early ontogeny* (pp. 15–46). New York: Cambridge University Press.
Trevarthen, C., & Aitken, K. J. (1994). Brain development, infant communication, and empathy disorders: Intrinsic factors in child mental health. *Development and Psychopathology*, *6*, 597–633.
Trevarthen, C., & Hubley, P. (1978). Secondary intersubjectivity: Confidence, confiding, and acts of meaning in the first year. In A. Lock (Ed.), *Action, gesture, and symbol* (pp. 183–229). London: Academic Press.

