

and possible functions of affect attunement as a special form of "social perception."

The phenomenon of affect attunement is best described by examples. Affect attunement is often so embedded in other behaviors that relatively pure examples are hard to find. The first five examples are relatively unencumbered by other goings-on.

Example 1. A 9-month-old girl becomes very excited about a toy and reaches for it. As she grabs it, she lets out an exuberant "aaaah!" and looks at her mother. Her mother looks back, squinches up her shoulders, and performs a terrific shimmy of her upper body—like a go-go dancer. The shimmy lasts only about as long as her daughter's "aaaah!" but is equally excited, joyful and intense.

Or, more commonly, the infant's behavior is non-vocal and the parent's is vocal, such as:

Example 2. A 9-month-old boy bangs his hand on a soft toy, at first in some anger, but gradually with pleasure, exuberance, and humor. He sets up a steady rhythm. Mother falls into his rhythm and says "kaaaa-bam, kaaaa-bam"—the "bam" falling on the stroke and the "kaaaa" riding with the preparatory upswing and the suspenseful holding of his arm aloft before it falls.

Example 3. An 8½-month-old boy reaches for a toy, just beyond reach. Silently, he stretches toward it, leaning and extending arms and fingers fully out. Still short of the toy, he tenses his body to squeeze out the needed extra inch of reach. At that moment, his mother says "uuuuuh . . . uuuuuh!" with a crescendo of vocal effort, the expiration of air pushing against her tensed vocal cords. The mother's accelerating vocal-respiratory effort matched the infant's accelerating physical effort.

Example 4. A 10-month-old girl accomplished an amusing routine between her mother and upon doing so looks at mother. The girl "opens up" her face (mouth opens, eyes widen, eyebrows raise) and then closes it back in a smooth arch (∩). Mother responds with saying "yeah." However, she intones it so that its pitch line is "yeah." The mother's prosodic contour has matched the child's facial-kinetic contour.

Example 5. A 9-month-old boy is sitting facing his mother. He has a rattle in his hand and is shaking it up and down with a display of interest and mild amusement. As mother watches she begins to nod her head up and down keeping tight beat with her son's arm motions.

More often the attunement is so embedded in other actions and purposes that it is partially masked. The next example illustrates this.

Example 6. A 10-month-old girl finally gets a piece in a jigsaw puzzle. She looks toward mother, throws her head up in the air, with an arm flap raising herself partly off the ground in a flurry of exuberance. The mother says "YES, that a girl." The "YES" is intoned with much stress. It has an explosive rise that echoes the girl's fling of gesture and posture. One could easily argue that the "YES, that a girl" functions as a routine response in the form of a positive reinforcer. And it certainly does so. But, why does not the mother just say "yes, that a girl"? Why does she need to add the intensely intoned "YES . . ." that vocally matches the child's

gestures? The "YES," we suggest, is an attunement embedded within a routine response.

The embedding of attunements is so common, and most often so subtle that unless one is looking for them, or asking why any behavior is being performed exactly the way it is, the attunements will pass unnoticed (except of course we will gather from them—often unawares—what we imagine to be "really" going on clinically). It is the embedded attunements that give one much of the impression of the quality of the relationship.

What are the characteristic features of these phenomena and what shall the phenomena be called?

1. We receive the impression that a kind of imitation has occurred, yet there is no faithful rendering of the infant's overt behavior at all. This is why terms such as mirroring, echoing, and imitation are literally inaccurate as well as misleading. Yet, some form of matching is going on.

2. The matching is largely cross-modal or inter-modal, that is, the channel or modality of expression used by the mother to match is different from the channel or modality used by the infant. In the first example the child's voice is matched by the mother's body movements. In the second example the boy's arm movements are matched by the mother's voice. The transposition of the original is of such an extent, that terms like "modifying imitation" are being stretched too far.

3. The reference for the match appears to be the internal state (inferred or directly apprehended), not the external behavioral act. "Affect matchings" born of "contagion" is also an inadequate term to capture this phenomenon because in contagious affect matchings the overt behavior gets transmitted (as well as the feeling state), as in smiles begetting smiles. In our examples the overt behavior is not transmitted.

4. The match appears to occur between the expressions of inner state. These expressions can take forms that differ in mode, form, etc., but which have a potential substitutability as corresponding manifestations of a single, recognizable internal state. We appear to be dealing with behavior that is more fundamentally an "expressivism" than a sign or symbol. Here, the terms "mirroring" and "reflecting back" capture the essence of the thing when referring to the inner state alone, but miss capturing its mechanism.

5. The process occurs rapidly, and, as will be demonstrated, largely out of awareness and almost automatically. There appears to be insufficient involvement of cognitive processes to call this phenomenon simply another manifestation of empathy. Because of the unique features of this phenomenon and the problems with each of the existing terms that could be applied to it, we chose to call it "affect attunement." We mean by it, the performance of behaviors that express the quality of feeling of a shared affect state, but without imitating the exact behavioral expression of the inner state. A sharp distinction between imitation of external behavior and affect attunement with internal state must be maintained to do justice to observable events. To put the situation most simply, if the mother wishes to attune with the infant or to show attunement for the infant's sake, why does she not simply

2. mother then displayed behavior which gave the *impression* of imitating, mirroring, matching, or attuning in any way to the infant's behavior, and
3. the infant either could see or hear her behavior.

The TV tape was replayed until either 10 attunements had been scored or 10 minutes had elapsed. Accordingly, the amount of time examined for each mother varied.

Despite the fact that the interrater reliability of agreement about the occurrence of an entry criterion was high ($r = .92$), it can be argued that the definition of entry is imprecise because it rests on the "impression" of attuning or matching or imitating by the mother. It must be recalled that one of the purposes of the study was to examine the phenomenon of imitation, mirroring, matching, attuning, etc., as these are broadly used. Accordingly, the decision was made to rely on subjective criteria for inclusion decisions and then study the phenomenology of the behaviors that fell into that category. To do otherwise would have been to decide on the answer to a major question of the study, *a priori*. As a check, however, we also scored and will report on all events where criterion 1 was met, but mother made any other kind of response in addition to attunement or imitation. These other kinds of maternal responses to infant affect displays include many response categories: positive or negative reinforcements, question, interpretations, running commentary, etc. We have lumped all these together and called them comments. (See Dore, 1983, 1984.) Accordingly, the three types of maternal responses to an infant affect display are: attunements, imitations, or comments. Scoring this broad category of comments was necessary to make the scoring system inclusive of all mothers' responses. Only then could we determine the relative frequency of attunements, given an infant affective behavior to which the mother would respond in some manner. (See Dore, 1983 and 1984, for other alternatives.)

Behaviors scored

While we are calling the process attunement, we scored behaviors in terms of various kinds of *matches*.

Modality of Matches. The modality(ies) and body part in which the infant's affect was expressed were scored. These were: vocal, respiratory, facial, gestural, movement of head, body, limbs. The modalities and body parts in which the mother matched the infant's behavior were also scored. For each event one or more modalities could be scored for each partner. In this manner, a record was kept of whether the attunement consisted of matches that were in the same mode, crossed modes, or mixed modes.

Interrater reliability of modality or body part used was, $r = .91$.

Dimensions of Attuning Matches. How were we to define attuning matches which were not strict imitations? This is the crux of the problem. The following dimensions of the infant's behavior were determined *a priori*, on the basis of pilot observations, to be the ones that the mother could match in establishing attunements without actually imitating the infant: intensity, timing, and shape. Two different types of intensity matches, three types of timing matches, and one type of shape matches were used.

imitate the infant? When the mother, or anyone else, is experiencing the sharing of an affect state we do not see flurries of rampant imitation. Rather we see attunement behaviors, that is, behaviors which reference the internal state, but which bypass true imitation by skirting any true reproduction of external behaviors. If we could demonstrate subjective affect sharing only by true imitation, we would be enormously limited, maybe even robot-like.

The reason attunement behaviors may be so important as separate phenomena is that imitation does not permit the partners to "refer to" the internal state. It maintains the focus of attention upon the forms of the external behaviors. Attunement behaviors which "recast" the event are needed to shift the focus of attention to the inside, to the quality of feeling that is being shared. It is for the same reasons that imitation is the preferred way to teach the external forms and attunement the preferred way to commune with or indicate sharing of the internal states. Imitation renders form. Attunement renders feeling. However, in real life there does not appear to be a true dichotomy between attunement and imitation, rather they occupy two ends of a spectrum.

The following pilot study represents our first attempt to examine these phenomena systematically.

METHOD

Subjects

Ten normal white, middle-class mothers participated with their five boys and five girls who were between the ages of 8 and 12 months. Mean age was 11 months. All infants were healthy.

Procedure

Play interactions between mothers and infants were televised in an observation room. Two TV cameras located outside the room and on opposite sides recorded the behaviors of infant and mother. The camera with the best view was chosen to record. When needed, recordings from both cameras were taken to produce a split-screen image. Play sessions lasted 15 minutes. They were preceded by a warm-up period of variable length depending on baby state, hunger, etc., but never less than 5 minutes. The mothers were instructed "to play with their infants as they normally do at home." They were requested to bring two of the infants' favorite toys to the observation room. Two other toys were also present. The mothers were further told that immediately after the taping, we, the authors and the mother, would watch and talk about the TV replay of the interaction.

During the replay, the TV play-back was stopped whenever an "event" (see below) occurred. The event was replayed as often as we or the mother wished, to score the behaviors and answer the questions.

Entry criteria for scoring behaviors from the TV records

The definition of an event which constituted the entry criteria for data scoring was:

1. whenever the infant displayed any affect that represented a marked change over immediately preceding behavior.

over immediately preceding behavior.

Intensity Matches: *Absolute level of intensity.* If the infant performed an affective behavior at a given level of intensity (vocal, or kinetic) and the mother matched the absolute intensity level of his affective behavior in her response, then a match was scored.

Directional shift inintensity (intensity contour matches). If the infant's behavior described a clear intensity contour—for example, steadily rising intensity, accelerating rise, rise then fall, etc.—and the mother matched the temporal dimensions and direction shifts of this dimensional feature, an intensity contour match was scored.

Timing Matches. *Beat matches.* If the mother's behavior (regardless of intensity or shape) matched the beat of the infant's behavior, a beat match was scored.

Rhythm matches. If the mother's behavior (regardless of intensity or shape) matched the rhythm (a beat with unequal stress) of the infant's behavior, a rhythm match was scored.

Duration matches. If the mother's matching behavior (as established by one of the above types of matches) had roughly the same duration as the infant's, a duration match was scored. A duration match, by itself, was not considered sufficient to establish attunement. Duration matches were thus only a secondary dimension of matching. "Roughly the same duration" was taken to mean to the observers that the maternal matching behavior "seemed" as long as the infant's. No actual durations were measured.

Shape Matches. Shape matches refer to maternal matches that reproduce the temporal structure of changes in the form of the infant's act, without imitating it. For example, the infant shakes the rattles *up and down* and the mother nods her head *up and down*. This kind of match cannot be captured in the intensity or temporal dimensions.

The interrater reliabilities for the matches of the various dimensions were: absolute intensity level, $r = .81$; intensity contour, $r = .95$; beat, $r = .83$; rhythm, $r = .66$; duration, $r = .80$; shape, $r = .87$.

Maternal awareness of her behavior

Mothers were asked to rate on a 3-point scale whether they were aware of performing the match at the time of actual performance: (1) entirely unaware, (2) with partial but not total awareness, and (3) with full awareness.

Type of attunement

Mothers and experimenters were asked whether their behavior was meant to be an equal match, an over-match, or an under-match. Equal matching was explained to mean that the mother intended to match the infant's behavior in intensity, shape, and time. Over-matching referred to maternal attempt to perform her side of the match at a higher, greater, faster, or exaggerated level with regard to intensity, shape, and time. Under-tuning referred to the opposite.

matches were used.

The function of the attunement

Mothers (and separately experimenters) were asked to determine the intended functions of the matching behavior. The following six functions comprised the choices. (these were determined from pilot studies).

- (1) "To be with" (positively). This included intentions such as, to join in, to be with, to participate in, to share.
- (2) "To be with" (negatively). This included intentions such as, to mock, to make fun of, to parody. In these instances the mother appeared to "join in," but with negative interest.
- (3) Responses. This included intentions where the maternal behavior was a contingent response of any of the following kinds: to reinforce (to approve, to disapprove); to indicate attentiveness; to underline or mark the presence of a behavior; to acknowledge; to cap off, in the sense of finishing a standard sequence.
- (4) *Tuning.* This included all intentions to increase or decrease the infant's level of arousal, affect, or activity through over- or under-matching, that is, to "jazz up" or calm down the baby through example, not through comment.
- (5) *Restructure Interaction.* This included intentions to change the agenda, to attract attention to mother, and to teach in the sense of elaborating didactically, including to teach word uses.
- (6) *A play routine.* This included matches which were an obligatory part of a known play routine such as pat-a-cake.

Inter-rater reliability among experimenters varied widely depending on function. To be with, $r = .88$, response, $r = .80$, tune, $r = .33$, change agenda, $r = .86$, overt play, $r = .67$. Reliability between experimenter and mother for function overall was, $r = .70$.

RESULTS

Frequency of attunements

The ten infants produced 151 affect displays that met the criteria of maternal response in 77.5 minutes. Of the 151 displays the mothers responded to 48% with affect attunements, 33% by comments, and 19% with imitations. Maternal attunements were, for the group, the most common response to an infant affect display, accounting for almost half. Attunements occurred at an average rate of once every 65 seconds, comments once every 92 seconds, and imitations once every 162 seconds.

Table 1 shows the frequency of attunements, comments, and imitations for each mother.

While six (one tie) of ten mothers responded most frequently with attunements, 4 (one tie) mothers (#1,2,3,10) commented most frequently and one mother (#8) imitated most frequently.

The feature of infant behavior attuned to by mothers

The feature of behavior in the infant's affect display that the mother attuned to is shown in Table 2. The infant's affective displays are sometimes made of only one kind (feature) of behavior, for example, a vocalization. More commonly, they are composed of several features from several modalities performed at the same time, for example, a vocalization with a facial display, with a gesture, etc., to form a behavioral "package." Table 2 indicates which feature of the infant's behavioral package the mother attuned to.

The features of infant vocalization (57.2%), gesture (51%), and facial display (47.2%) were the most likely to be attuned to. Nine of ten mothers made the greatest number of attunements to one or several of these three features.

The feature of behavior that mothers use to make the attunement

The behavioral responses of the mothers are also generally composed of several features. The feature of her behavior that she used to attune to the infant's behavior is shown in Table 3.

Eight of ten mothers use their vocalizations as much as or more than any other feature of their behavior to attune to the infant's behavior. As a group, vocalizations were used in 73.1% of all attunements.

Facial displays were the next most common feature of maternal behavior used to attune. Two of ten mothers used it most often. As a group, facial displays were used in 46.2% of all. The other features were used far less frequently.

Are attunements cross-modal or intra-modal?

The mother can match the infant's behavior to create an attunement in the same modality, cross-modally, or both. If the infant vocalizes, the mother can attune by matching the infant's vocalization with a vocalization (intra-modal), or with a gesture (cross-modal), or with both features of her behavior (mixed-modal). Table 4

Table 1. The Absolute Frequency of Attunements, Comments, and Imitations Performed by Each Mother (Expressed as Number of Events/Minute)

Mother	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	X
Attunements	1.07	1.21	0.77	1.16	1.96	2.67	0.72	0.57	1.04	0.13	1.07
Comments	0.70	1.57	0.44	0.23	1.37	0.80	0.31	0.34	0.35	0.13	0.70
Imitations	0.43	0	0.22	0	1.18	0.80	0.10	1.14	0	0.19	0.43
Total minutes needed to occur	8.28	9.12	7.75	8.62	5.10	3.75	9.68	8.77	8.63	7.77	8.28
plays											

Table 2. The Feature of Infant Behavior Attuned to by each Mother (Expressed as a Percentage of Total Attunements of each Mother*)

Feature of Behavior	Mother										X
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	
vocalization	10	25	67	30	50	60	57	80	33	100	57.20
gesture	20	75	50	30	70	70	71	20	0	100	51.10
head motion	30	0	50	60	0	20	57	20	78	0	31.50
body motion	20	0	17	0	20	30	57	40	0	100	28.40
facial display	10	25	33	80	80	40	86	40	78	0	47.20
respiration	10	0	17	0	10	20	14	0	0	100	17.10
# attunements	10	4	6	10	10	10	7	5	9	1	

* Since a mother can attune to more than one feature at the same time, the sum of the columns is greater than 100%.

Table 3. The Feature of Behavior that Mothers use to Make the Attunement (Expressed as a Percentage of Total Attunements of Each Mother^a)

Feature of Behavior	Mother										
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	X
vocalization	80	75	83	60	30	70	86	80	67	100	73.10
gesture	0	75	0	20	0	0	14	0	0	0	10.90
head motion	0	25	17	70	50	43	20	20	78	0	17.30
body motion	20	0	0	70	20	43	20	0	0	0	19.30
facial display	10	25	33	80	80	50	57	60	67	0	46.20
respiration	10	0	0	20	10	60	43	0	11	0	15.40
# attunements	10	4	6	10	10	10	7	5	9	1	

^a Since a mother can attune with more than one feature of her behavior at the same time, the sum of the columns is more than 100%.

shows the percentage of attunements occurring in the same mode (intra), different modes (cross), or both (mixed).

As a group, mixed modal matches were most common (48.2%). Strictly cross-modal matches (38.8%) were far more common than strictly intra-modal matches (13.0%). On an individual basis four mothers (#1,3,4,10) used cross-modal matches more often. Four mothers (#2,5,6,8) used mixed-modal matches more often. One used mixed and crossed equally (mother #7). Only one mother (#9) used intra-modal matches most often.

These figures, while impressive concerning cross-modal matches, tend to minimize the actual extent of cross-modal matching. During most of the matches in which the mother is using both the same and a different mode to match the infant (i.e., mixed matches) the cross-modal match was usually the more marked or emphasized match than the concurrent intra-modal one. This remains an impres-

Table 4. The Percentage of Cross-Modal, Intra-Modal, and Mixed Modal Attunements

Nature of Attunement	Mother										
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	X
cross-modal matches	50	25	60	60	30	20	43	0	0	100	38.80
intra-modal matches	10	0	0	0	0	10	14	40	56	0	13.00
mixed (both cross and intra) modal matches	40	75	40	40	70	70	43	60	44	0	48.20
# attunements	10	4	6	10	10	10	7	5	9	1	

sion, though a strong one, since we did not operationalize relative emphasis within a mixed match.

Dimensions of Attunement

Attunements can occur on the basis of matches (a) in intensity (absolute level and/or contour, i.e., the profile of change in intensity over time); (b) in time (duration, beat, rhythm); or (c) in shape. Table 5 shows the percentage of attunements based on each of the separate dimensions.

The group data show that intensity was the most common dimension of matching (97.0%), time the next most frequent (76%), and shape the least (37.9%). Individual differences were not striking. The dimension of intensity contour was the single most frequent subdimension of matching (80.7%).

The Function of Attunements

Both the experimenters and mothers judged what the mother intended to accomplish by her attunement. These judgments are more attributions of purpose or function. Table 6 shows the functions attributed to attunements by the experimenters and by the mothers, commenting on their own behavior.

Overall, the experimenters attributed the following functions to the mother's

Table 5. The Percent of Attunements Based on the Dimensions of Intensity, Time, or Shape (Expressed as Percentage of the Total Attunements for Each Mother^a)

	Mother										
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	X
Intensity level	100	25	83	60	70	80	57	80	56	0	61.1
contour	100	100	83	70	100	70	57	60	67	100	80.7
level and/or contour	90	100	100	90	100	90	100	100	100	100	97.0
Time duration	60	50	83	70	80	90	43	60	56	100	69.2
beat	0	50	0	10	10	0	57	0	0	0	12.7
rhythm	0	0	33	0	0	10	71	0	0	0	11.4
duration and/or beat and/or rhythm	60	75	83	70	80	90	86	60	56	100	76.0
Shape # attunements	40	50	50	40	30	30	43	40	56	0	37.9
	10	4	6	10	10	10	7	5	9	1	

^a The percentage for each mother adds up to more than 100% because a mother can attune on several dimensions at the same time.

Table 6. The Function of Attunements as Attributed by Experimenters and Mothers (Expressed as Percentage of the Total Attunements for Each Mother)

Attributed Functions	Mother										
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	X
to commune	50	100	17	50	50	70	0	80	33	0	45.0
to respond	40	0	50	10	50	30	71	20	66	0	33.0
to tune	0	0	17	40	0	0	29	0	0	100	18.6
to restructure the interaction	0	0	17	0	0	0	0	0	0	0	1.7
to follow a play routine	10	0	0	0	0	0	0	0	0	0	1.0

Attributed Functions	Mother										
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	X
to commune	10	50	17	20	50	50	86	0	11	100	39.4
to respond	70	50	50	50	30	20	14	100	66	0	45.0
to tune	0	0	17	30	20	30	0	0	33	0	13.0
to restructure the interaction	20	0	17	0	0	0	0	0	0	0	3.7
to follow a play routine	0	0	0	0	0	0	0	0	0	0	0
# attunements	10	4	6	10	10	10	7	5	9	1	

attunements: to commune (45%), to respond (33%), to tune (18.6%), to restructure the interaction (1.7%), and to follow a play routine (1.0%). The mothers made similar attributions except that they reversed the order of responding (45%) and communing (39.4%). Some individual differences are apparent and agreed upon by both experimenters and mothers. For instance, both agree that mothers #3 and 9 use attunements more in the service of responding than communing, while mother #6 does the reverse. On a case by case basis the agreement between experimenters and mothers was poor. Nonetheless, there is agreement that attunements are used mainly to commune or respond.

Maternal Awareness of Her Attuning Behavior

Each mother was asked after viewing each attunement whether she had been unaware, partially aware, or fully aware of her attuning behavior at the time of its occurrence. Table 7 shows the percentages of attunements that fell into each category of awareness for each mother.

Table 7. Maternal Awareness of Her Attuning Behavior (Expressed as the Percentage of Total Attunements for each Mother)

Awareness Category	Mother										
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	X
unaware	80	50	0	70	60	0	71	40	11	0	38.2
partially aware	20	50	100	0	40	10	29	0	46	0	29.5
fully aware	0	0	0	30	0	90	0	60	33	100	31.3
# attunements	10	4	6	10	10	10	7	5	9	1	

The group data show that overall mothers judge themselves to be roughly equally divided between being unaware (38.2%), partially aware (29.5%), and fully aware (31.3%) of their attuning behavior at the time of its performance. There are large individual differences in mothers' perception of their level of awareness while engaged in this activity. Some mothers experience (or report) themselves to be fully aware most of the time (mothers #6, 8, 10) while others experience or report themselves to be unaware most of the time (mothers #1, 4, 7). Mothers #3 and #9 found themselves most frequently to be partially aware.

The infant's response to the mother's attunement

It is easy enough to determine when misattunements (intentional and unintentional) influence the infant. They usually result in some alteration or interruption of ongoing infant behavior. That is their purpose, and it can be readily gauged. The situation with communing attunements ("to be with," "to share" with the baby) is different. Most often, after the mother has made a communing attunement, the infant acts as if nothing special happened. He continues about his business, and we are left with no evidence, only speculation, that the fact of attunement has "gotten in," taken hold, and had some consequence. To get underneath this still surface we chose the method of perturbing ongoing interactions to see what happens.

The approach of creating defined perturbations in naturalistic or semi-naturalistic interaction is well established in infancy research. Our perturbations had to be uniquely dyad-specific, tailored and aimed at an already identified and likely to occur attunement event characteristic of a particular mother-infant pair. No two pairs presented the same opportunity.

The specific attunement episode chosen for perturbation was identified while watching the replay of the TV recording with the mother. After discussing the structure of behaviors that made up the attunement episode, the mothers were instructed in how to perturb the structure. They then returned to the observation room, and, when the appropriate context for the expectable attunement behavior arose, they performed the planned perturbation. An example serves best.

A 9-month-old crawls away from mother and over to a new toy, and while on his stomach grabs the toy and begins to play, especially banging and happily flailing

with it. His play is animated, as judged by his movements, breathing, and vocalizations. Mother then approaches him from behind, out of sight, and puts her hand on his bottom and gives it an animated jiggle side to side. The speed and intensity of her jiggle appear to match well these aspects of the infant's behavior, qualifying this as an attunement. The infant's response to her attunement is—nothing! He simply continues his play without dropping a stitch. Her jiggle left no overt trace, as if she had never acted. This attunement episode was fairly characteristic. The infant again wandered from her, became involved in a toy, she leaned over and jiggled his bottom or leg or foot. And the sequence would repeat over again.

The first perturbation was to instruct the mother to do exactly the same as always, except this time purposely "misjudge" her baby's level of joyful animation, to pretend that the baby is somewhat less excited than he appears to be and jiggle accordingly. When the mother did jiggle somewhat slower and less intensely than she judged would make a good match, the baby quickly stopped playing and looked around at her, as if to say, "What's going on?" This was repeated twice with the same results. The second perturbation was in the opposite direction. The mother was to pretend that her baby was at a higher level of joyful animation, and jiggle accordingly. The results were the same—the baby stopped and looked around. The mother was then asked to jiggle appropriately as she originally did, and again the infant did not respond.

Many such individualized perturbations have been performed, all indicating that the infant does, indeed, have some sense of the extent of matching, and that goodness of match, in-itself, is an expectation under some circumstances, and its violation meaningful (Stern, in press).

Discussion

One of the first features of the data that invites comment is the predominance of cross-modality in the maternal responses. And, it is this feature that provides one clue as to the mechanism underlying affect attunement. For attunement to work, different behavioral expressions in different forms and different sensory channels may be interchangeable. They must share some common currency that permits them to be transferred from one mode to another. There are some attributes or qualities of perception that are held in common by most or all the modalities of perception, such as intensity, shape, time, motion, number, etc. These qualities of perception can be abstracted by any sensory mode from the invariant properties of the stimulus world, and then translated into other modalities of perception. For this to occur, the perceptual quality must in some way exist in the mind in a form which is not inextricably bound to one particular way of perceiving it, but which is sufficiently abstract to be transposable across modalities. The abstract amodal form of any of these qualities may well exist as abstract mental representations of the quality. It is the existence of these abstract representations of amodal qualities that permits us to experience a world that is perceptually unified.

The work of many researchers has contributed to the view that the infant (and mother) experiences, from very early in life, a world of perceptual unity, in which

amodal qualities can be perceived in any modality from any form of human expressive behavior, represented abstractly and then transposed to other modalities. (Bower, 1974; Field, Woodson, Greenberg, & Cohen, 1982; Gibson, 1969; Kuhl & Meltzoff, 1982; Lewcowitz and Turkewitz, 1983; MacKain, Studder & Kennedy, Spicker, & Stern, 1983; Marks, 1978; Meltzoff & Borton, 1979; Meltzoff & Moore, 1977; Rose, Blank, & Bridger, 1972; Ruff, 1980; Spielke, 1976; Wagner & Sakowitz, 1983.)

On the basis of this background, we would speculate that the basic capacity to recognize cross-modal correspondences provides the foundation for that particular form of "person perception" that captures the quality of another's inner feeling state. This is what we are calling affect attunement.

It is worth noting that when we initially chose intensity, timing, and shape as the three dimensions of matchings to score for attunements, we did not do so on the basis of the fact that there was experimental evidence that infants can treat these three qualities amodally. The relevance of these facts became apparent later in the findings. Our choice was on clinical-descriptive grounds alone, that is, those qualities seemed to be the best descriptors and thus definers of what intuitively felt like attunement. Thus, the choice could be interpreted as lending some added weight of convergent validity to the importance of the amodal perception of these qualities of experience in social perception.

A second feature of the data requiring comment is the automaticity and relative lack of awareness of attuning behaviors. Even in the one-third of occasions when mothers said they were aware of doing what they did and could provide a rationale for it, on closer questioning it was clear that rarely were they aware that they did what they did *exactly* the way they did it.

This relative noninvolvement of cognitive processes related to the perception of role, projection, identification, etc., is important. Most writers about the process of empathy (e.g., see Hoffman, 1978), and this includes psychoanalysts as well as developmental psychologists (e.g., see Schafer, 1968), require that several cognitive processes or steps intervene between the perception of someone's feeling state and the elaboration of a truly "empathic response." These steps do not appear to be part of the process of affect attunement, yet affect attunement and empathy both require the initial feeling-what-has-been-perceived in-the-other. In affect attunement, it is as if the route to empathy had been departed from.

These issues lead to a third feature of the data. According to the entry criteria imposed, we only found one attunement every minute or so. While this was adequate for the purposes of the pilot study described, it does not capture the feel of the situation. Attunement as a form of feeling-connectedness to another is mostly experienced as a process unbroken in time (which like empathy can wax and wane). Our entry criteria captured the highest peaks that occurred roughly every minute, but left unrevealed the rest of the mountain range. Mothers or anyone can, in fact, make attunements with anything the infant does—not just with the affect displays we chose to study. Attunements can be made with the inner quality of feeling of how an infant reaches for a toy, holds a block, kicks his foot, listens to a sound, etc. We

pression) to occur to re-establish attunement. It feels like an unbroken process. It seeks out the form of vitality momentarily ongoing in any and every behavior (including affect displays) and uses that to keep the thread of connectedness unbroken.

A fourth feature of the results that requires further comment is the fact that the largest category of functions for attunements was the category that included "to be with," "to share," "to participate in," and "to join in." We have called these functions *interpersonal communion*. This group of functions stands in contrast to the other functions given: to respond, to tune the baby up or down, to restructure the interaction, to reinforce, to teach, etc. This later group can be lumped together as serving the function of communication rather than communion. Communication generally means to exchange or transmit information, usually with propositional content, or to attempt to alter another's belief or action system. During many of these communing attunements, the mother is doing none of these things. Communication, on the other hand, means to participate together or to share in another's experience without altering their behavior. This captures far better the mother's behavior as seen by experimenters and by mothers themselves. The notion of communion as a separate form of interaction, and its relationship to communication, needs further exploration. Communion, as a concept, comes closer to the idea of maintaining the thread of feeling-connectedness that was mentioned above.

The developmental import of affect attunement will necessarily be a function of the infant's age and of his ability to utilize this form of social perception. During the first half year of life it is our impression that modifying imitations predominate over attunements (the reverse is true after 9 months). However, the role of both in initiating, maintaining, regulating, and terminating infants' social behaviors has been richly commented on by Papoušek and Papoušek (1979) and Beebe, Kronen, and Gerstman (1983) in the first 6 months of life. During this earlier period, however, the infant has less capacity to sense that he is being attuned with or imitated, and less cognitive capacity to infer about such events. These maternal behaviors simply have a direct effect on the infant's state and behavior. Beginning at around 9 months, however, the infant crosses an interpersonal threshold that makes of attunement a different experience. He can now deal with a metaphoric "recasting" with an alternative expression of his own inner state.

At about 9 months the infant comes to the momentous but gradual discovery that he has a mind and that other people have separate minds. Intersubjectivity is now possible (Trevarthán & Hubley, 1978). It is at this point in development that the infant begins to sense that he can "have," so to speak, or "occupy" a mental state. And he now begins to impute mental states to others. Further, he comes to sense and even expect that his mental state and that of another can be interfaced. He is arriving at a "theory of interfaceable minds" (Bretherton and Bates, 1979). This conclusion seems inescapable when developmental evidence about infants' pointing gestures, language acquisition, and intentions to communicate all converge to indicate that the infant acts as if focus of attention, and intentions were now parts of the sharable world (Bates, 1979; Bates, Camaí, & Valterra, 1975; Bloom, 1973; Bower, 1974;

have just passed into a different domain of feeling than that encompassed by the traditional or Darwinian affect categories.

We need a new category or property of feeling quality that is manifest in all behavior and can thus be an almost omnipresent subject of attunement. A quality that concerns *how* a behavior, any behavior, all behavior is performed, not *what* behavior is performed. This property can be encompassed by considering the intensity and timing alone (97% of all attunements utilized the dimension of intensity, and 76% the dimension of timing; the change in intensity over time gives rise to a feeling quality). We will call this needed quality of feeling, *vitality*, of which there are many distinct contours. By vitality contours we mean those dynamic, kinetic qualities of feeling that distinguish animate from inanimate and that correspond to the momentary changes in feeling states involved in the organic processes of being alive. Vitality is captured in terms such as: exploding, surging, fading, fleeting, persistent, drawn out, descrecendo, etc. Contours of vitality are not the same as discrete conventionalized affects. A smile can be "explosive" or "fading." And the way a parent reaches for the bottle can reveal multiple contours of vitality to the infant—but usually no single affect. (Most abstract art concerns vitality contours, not affects [Langer, 1967]). In most accounts of affects, what we are calling vitality contours would be subsumed under the all-purpose dimension of level of activation or arousal. Activation and arousal certainly occur, but we do not simply experience a feeling somewhere "along" or at some point "on" this dimension. We experience them rather as dynamic micro-momentary shifts of intensity over time that are perceived as patterned changes within ourselves and others. We must reconceptualize the dimension of activation into separate and discrete configurations of activation as contoured in time, and think in terms of *activation contours*. And activation contours are (as we have noted) a combination of the supra-modal qualities of intensity and time that infants are so good at transposing across modalities.

The issue of vitality as a distinct form of feeling to be considered alongside of affect categories (happy, sad, etc.) is an important issue in and of itself. It is treated in greater detail and depth elsewhere (Stern, in press). The notion, in one guise or another, of forms of vitality as a separate part of the subjective world of feeling is well prepared for in the work of Schucirila (1965) and Tompkins (1962). It's also very close in concept to the notions behind Effort Shape analysis (Lamb, 1965) and other forms of dance or movement notation that have been applied to human social behavior, including that of mothers and infants (Kestenbaum, 1975).

For our purposes here, contours of vitality must be added to affect categories as one of the subjective inner states that can be referenced in acts of attunement. Vitality is ideally suited as the inner feeling that is the subject of attunements because it resides in virtually any behavior one can perform and thus provides a continuously present (though changing) subject for attunement. In this way, affective tracking or attuning with another can occur as a continuous process. One need not wait around for a discrete (Darwinian) affect display (such as a surprise ex-

Bruner, 1975, 1977; Collis and Schaffer, 1975; Dore, 1975, 1983; Greenfield and Smith, 1976; Halliday, 1975; Murphy and Messer, 1977; Scaife and Bruner, 1975; Shields, 1978; Trevarthen and Hubley, 1978).

This ushers in a new level of interpersonal relatedness, which we call *intersubjectivity relatedness* (Stern, in press), in which the sense of Self now includes a mental Self (in addition to the physical core-self) and the sense of Other also includes a mental Other. A mental Self and a mental Other that can be "interfaced" can also be aligned or misaligned, and mental alignment in the domain of feeling is attainment.

Attunement, then, at the interpersonal level of subjective relatedness becomes a powerful tool in social development, especially as it relates to clinical matters. The clinical implications of attunements, mis-attunements, and non-attunements are beyond our present scope and will be treated elsewhere (Stern, in press). Suffice it to say that what is at stake for the infant are issues such as the following: The extent and the specific contents of the subjective world of feeling that are attained to will be considered "sharable," and may become the subject matter of intimacy. That which is not attained to will remain private and may be experienced as idiosyncratic. It may not become "sharable" and by virtue of that may not become linguistically encodable. The complexification of the infant's growing interpersonal internal representations will be largely determined by which self-experiences are communed with and thus supported, and which are under parental pressure to be altered in one way or another. Also, the infant's sense of Self as "reflected" by the parents will be shaped by the history of past and present attunements and misattunements.

Finally, there is the important clinical issue of how parental wishes, fantasies, and fears about their babies take on flesh and become operationalized to actually influence the interactions and the child's developmental course (e.g., Cramer, 1982; Fraiberg, 1980; Lebovici, 1983; Pinol-Douriez, 1983; Stern, 1971). The phenomenon of affect attainment sits at the interface between parental fantasy and observable interactional conduct. In being so positioned, it holds promise for investigating these powerful developmental influences that parents bring to the interaction with their infants.

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