

market reassurance usually given to anxious parents when no obvious physical defect is discovered shows both ignorance of the fundamental prerequisites for human communication and lack of concern founded on the traditional 'wait and see' attitude.

We no longer need to look the other way when a baby gives early evidence of communicative handicap from whatever cause. Preventive measures are now available for families in which communication problems are suspected and early intervention brings hope of improved outcome for babies with diagnosed disorders which affect communication and, therefore, total life adjustment. However, the most effective approach to problems involving human communication is to widen awareness of its significance among both professionals and the general public. This should start with awareness of its importance even at or before birth.

Notes

For their work in the specialist follow-up of the Helsinki study described in this chapter I would like to acknowledge Hilka Schugk, Sirrka Kruus, Maija Wilska, Tapani Jauhainen, Christina Raita, Yappo Taipale, Sinikka Maliniemi, Ole Wasz-Höckert and Olivia Ollila. The study was financed by the Swedish Scouts' Association's Foundation for Handicapped Children and the First-of-May-Flower Campaign for Children with Difficulties (Förstamajblomman). Karolinska Sjukhuset (the Children's Clinic) and the Wenner-Gren Research Laboratory provided facilities. References to relevant literature may be found in the bibliography.

The name of my autistic daughter is Boel; her story is told in *The child in the glass ball* (1964). Her insoluble problem of communication resulted in the choice of the name BOEL for the screening procedure described. BOEL is also an acronym of the Swedish 'Blicken orienterar efter ljud' ('Gaze orientates after sound').

The attendance at well baby clinics in Sweden (as well as in Finland) is virtually 100%.

Compare Stenland Junker 1972: 14, 17-45.

16

Communication and cooperation in early infancy: a description of primary intersubjectivity

COLWYN TREVARTHEN
University of Edinburgh

1 Introduction

In film and television recordings of face-to-face interactions of mothers with their infants aged one to three months, my students and I have observed extremely complex behaviours that have led us to accept the idea that human beings are equipped at birth with a mechanism of personality which is sensitive to persons and expresses itself as a person does. Obviously such a mechanism must be formulated largely within the brain before birth without benefit of imitation or training; but the anatomy required seems to be unknown. Beyond question the acts of communication in early infancy are very immature, but they appear powerful enough to take charge of the process by which the cognitive processes of the mind develop. In the first few months, before manipulation is effective in exploring objects, an infant establishes the basis for a deep affectional tie to his mother and other constant companions. He does so by means of this delicate and specifically human system for person-to-person communication.

In this chapter I wish to review this behaviour of young infants to see how far the unspoken part of human communication is present long before the infant can speak and to investigate whether there are rudiments of speech activity as well. Such an inquiry is forced upon us when we admit that language may be part of the larger function of interpersonal communication that grows in the child.

1.1 Subjectivity and intersubjectivity: definition of terms

Human beings understand one another intimately and at many levels. To analyse this ability of persons to act together and to share experience in harmony, we have first to view communication in relation to

Infants are not speaking
but they are communicating

the private activities of conscious, purposeful action. All voluntary actions are performed in such a way that their effects can be anticipated by the actor and then adjusted within the perceived situation to meet the criteria set in advance. Interpersonal communication is controlled by feedback of information, as is all voluntary behaviour. But there is an essential difference between a person doing things in relation to the physical world and the control of communication between persons. Two persons can share control, each can predict what the other will know and do. Physical objects cannot predict intentions and they have no social relationships.

For infants to share mental control with other persons they must have two skills. First, they must be able to exhibit to others at least the rudiments of individual consciousness and intentionality. This attribute of acting agents I call *subjectivity*. In order to communicate, infants must also be able to adapt or fit this subjective control to the subjectivity of others: they must also demonstrate *intersubjectivity*.¹

By subjectivity I mean the ability to show by coordinated acts that purposes are being consciously regulated. Subjectivity implies that infants master the difficulties of relating objects and situations to themselves and predict consequences, not merely in hidden cognitive processes but in manifest, intelligible actions.

Acts that make subjective processes overt include the following: focussing attention on things, handling and exploring objects with interest in the consequences, orientating or avoiding while anticipating the course of events and meeting or evading them. Acts of these kinds have been found in research with infants that obeys the observational tenets of Piaget in his studies of cognitive development (1936). Of recent work on infant cognition in this tradition, Bower's (1974) is the most comprehensive. Infants one or two months of age may be observed to look at, listen to and touch objects with the beginnings of alertness for the changes in experience that follow what they do. They also perform rudimentary acts of grasping and manipulation, stepping, avoidance or withdrawal which, while ineffectual, have already enough adaptive form to be identified with these purposes (Trevarthen 1974b, forthcoming). Such patterned and intelligible activity, guided by its effects, shows the subjectivity of infants in their dealings with physical things.

Infants also show distinctive behaviours to persons. In the second month after birth their reactions to things and persons are so different that we must conclude that these two classes of object are dis-

tinct in the infant's awareness (Trevarthen forthcoming). They seek physical objects as sources of perceptual information or interest, and also as potentially graspable, chewable, kickable, step-on-able or otherwise usable (Trevarthen 1974b, 1975). But persons are communicated with by expressive movements.

It seems at first sight confusing that infants exhibit affective relations to objects over which they are attempting mastery in perception and action. They seem to be trying to communicate feelings to things as well as to people. But is this really what they are doing? This emotional aspect of infant behaviour, which goes beyond either regulation of an internal state of arousal or perception of contingency, has been little studied simply because most psychologists have rejected it out of hand. Nevertheless, pertinent observations have been made. Emotionality in young infants has, for example, been recorded and recognised to be of great importance in relation to learning and cognitive prediction by Papoušek (1967, 1969) and Papoušek & Papoušek (1977). Piaget (1936, 1946) records expressions of 'pleasure in mastery' and 'serious intent' with respect to cognitive tasks, and Wolf (1963, 1969) observed that smiling and cooing or crying of young infants may accompany and signal recognition of a familiar toy.

Facial expressions, closely similar to those of adults for the emotions of pleasure, displeasure, fear, surprise, confusion and interest may be distinguished in newborns, or young infants (Charlesworth & Kreutzer 1973; Oster & Ekman forthcoming). These movements are automatically perceived as 'emotional' by adults. They move other people and strengthen the apparent personality of the infant. Some, such as the smile, are clearly related to events over which the infant has claimed some degree of predictive control. A six-week-old may show pleasure at predicting correctly and displeasure at failure, even if satiated and refusing a physiological 'reward'. The expression of pleasure relates to the cognitive (subjective) prediction itself (Papoušek 1969; Zalazo 1972). In any attempt to understand infants as communicators it must be noted that the effect of the emotional expression can only be interpersonal. Only another person capable of emotion can be influenced by an emotional sign. Like adults, infants act as if they both know and care about events in their world. Indeed their relationships with other persons would be impossible without the aspects of subjectivity manifested by their prolific but organised emotional expressions.

1.2 The sample, and methods of research

The following account is focussed on evidence of intersubjective processes between mothers and their infants. This evidence is gleaned from films and video recordings of 165 'staged' encounters with their mothers of thirty-four (fifteen male, nineteen female) infants in their second and third months, some at the Harvard Center for Cognitive Studies but most at the Department of Psychology, University of Edinburgh.²

The techniques used have been designed to obtain detailed records of both mother and infant while they are in close communication. The artificial setting does not inhibit rich and close interaction. Mothers visit the laboratory from the time their babies are two to three weeks old. The baby is supported in an infant chair facing, but separate from, the mother. This allows free limb movement. The mother, seated close to her infant, is simply asked to talk to her baby. With the aid of a mirror, both mother and infant behaviours are recorded in near full face on video and film. Combination of video recording including sound with short selections on silent film permits survey of samples of behaviour lasting an hour or more on video and detailed analysis of patterns of action lasting seconds to a few minutes on film. The film is inspected frame by frame on a Perceptoscope projector with variable speed of projection. A back-projection arrangement permits tracing of the film to prepare graphic montages of patterns of action.

The films are of infants with their mothers. A few samples with other females or fathers as partners show that mothers are not absolutely unique, but there are not enough of these to permit comparative statements.

For convenience, expressive and receptive functions of infant and mother will be considered separately. This separation helps start analysis, but it is unnatural both with respect to the way each subject integrates experience with what he or she does and with respect to the intimate cooperation between them. Eventually we will have to put actions and reactions together again to determine how their form depends on their relations within an interplay controlled by both partners.

2 Communicative expressions of young infants

Here I am confining attention to expressions which lead to interper-

sonal communication, leaving aside well-known feeding, defensive or distress behaviour and signals of physiological state, all of which, while invoking others, are self-regulatory for the infant and disruptive of reciprocal intersubjectivity. The most familiar early expressions, cooing and smiling, are not the only ones pre-adapted to intersubjective exchange. Some of the less familiar expressions seen more important to psychological development. All appear clearly about the end of the first month.

Cooing, also known as pleasure, positive or non-crying vocalisation, is effective as communication only if other persons hear it. Neonates coo weekly, often when alone. When coos become clear and strong in the second month, adults find them pleasing. Coos are easily stimulated by friendly attention and speech, and by toys, such as rattles, if they are moved before the baby's eyes (Wolff 1969). Babies coo when not distressed and especially when distress has been overcome. The appropriate mouth opening and shaping for cooing is often made silently by infants less than two months old (fig. 1). Our films show that mouth movements are patterned separately for speech before the motor coordination of vocal organs with the respiratory apparatus is adequate to produce reliably controlled sound. Vocalised cooing



Fig. 1 Infant expressions. Left: smile and scowl with set jaw (boy, 12 weeks); centre: above, coo (boy, 6 weeks), below, crying (girl, 6 weeks); right: simulations of disgust and sneer (girl, 6 weeks).

develops in the second month, apparently at least partly in independence of auditory feedback from self or others (Lenneberg et al. 1965). Neither babbling nor laughter develops until after the third month.

Smiling develops parallel to cooing (Washburn 1929; Spitz & Wolf 1946; Ambrose 1961; Wolff 1963). Even premature infants smile and recognisable smiles may occur within minutes of birth (Leboyer 1974). Neonates smile in response to attention, but more weakly and unpredictably than they will a few weeks later. They also smile spontaneously, usually in a fragmentary or ill-formed way, during irregular sleep or drowsiness (Herska 1965; Wolff 1966; Oster & Ekman forthcoming) (fig. 2). In the second month smiling becomes an effective social signal. Even totally blind two-month-olds smile to a voice or tickling, so the infant smile cannot be an imitative response to seeing the smile of others (Freedman 1964; Fraiberg 1968, this volume). Like cooing, it must be based on a motor pattern formed before birth.

Almost all adult facial expressions can be found in photographs and video records of newborns and infants (Darwin 1872; Herska 1965; Ekman 1973; Charlesworth & Kreutzer 1973; Leboyer 1974; Oster & Ekman forthcoming). Some infant expressions appear differ-



Fig. 2 24-day-old girl asleep. Born approx. 10 days post-mature, but typical of a neonate.

ent from adult expressions, in correlation with differences in facial structure (Oster & Ekman forthcoming). Cross-cultural studies of adults and children give evidence for an innate, pan-human facial 'vocabulary' of emotional signs (Ekman 1973; Ekman & Friesen 1971, 1975; Ekman et al. 1972; Eibl-Eibesfeldt 1970).

Our films confirm that emotional expressions can be recognised in infants (figs. 1 and 2). They also show facial movements which have little to do with emotion or mood. In relation to language the most significant non-emotional expressions are the lip and tongue movements which I have named 'prespeech' (fig. 3). Like other expressions mentioned, prespeech movements exist at birth, becoming much more distinct by the second and third months when most of our films were made.

By producing prespeech in systematic relation to the signals from a partner in face-to-face communication (see below), infants appear to express a rudiment of intention to speak to that person, although the movements differ from adult speech and are usually not voiced. For example, since young infants lack teeth, there can be no exact matches for the movements for sounds such as /h/, /v/ and /f/. Infant lower jaws are proportionately small, affecting mouth configurations used for vowel sounds and also limiting tongue mobility. Nevertheless, as fig. 3 shows, the movements closely resemble lip opening, tightening, pursing and closing and lip and tongue appositions essential to forming adult speech sounds. In photographs these configurations are distinguishable from all other forms of expression. The details of prespeech movements suggest that they are, from their first appearance, already part of a specific mechanism for speech. Furthermore, by directing illumination upward through the open lips during prespeech we have observed that the tongue is exceedingly mobile inside the mouth as well as at the front. Prespeech is emitted in episodes or bursts, often mixed with expressions for happiness, anger, disgust or surprise. But the speech-like movements may occur also when the face is otherwise at rest and quite free from expression of emotion or mood (fig. 3).

All such mouth movements of infants have been explained as being evolved from non-linguistic actions, like kissing or biting, and non-intersubjective acts, like turning to the breast, pushing out food, vomiting and breathing (Eibl-Eibesfeldt 1970; Andrew 1963; Blurton Jones 1971). The tenable hypothesis that these speech-like movements are related to speaking has not been explored.

Posturing of the head, which turns up, down or to the side in many forms of expression, and of the trunk and limbs, seems to be systematically related to particular facial expression (fig. 4). This observation leads to the working hypothesis that total patterns of body expression are present in infants. The most economical theory is that the patterns of expression through posture, which become stereotyped in dance



Fig. 3. Prespeech compared to adult speech. Normal speaking of an adult, not the mother, reading a word list. Photographed with a motor-driven Nikon at 4 frames per second. Girl, 7 weeks, during a period of excited communication in front of mother, but with gaze averted. Only climax postures shown.



Fig. 4 Gestures in communication. Top: large, waving hand above shoulder, extending fingers wide while vocalising (6-7 weeks); upper centre: touching two index fingers together, opposing index finger and thumb (7 weeks); lower centre: pointing index finger with pre-speech, pursed lips (7 weeks); bottom: 'disdain' or 'disgust', hand held to side, flexed down (7 weeks).

and theatrical mannerisms, are based on innate templates as Darwin (1872) proposed. Study of these patterns requires repeated analysis of videotapes or films or sorting of many photographs. Since it is impossible to attend adequately to several parts of the body in real time, pencil and paper or keyboard encoding from ongoing behaviour are unreliable.

Particular hand movements are closely associated with particular facial expressions, forms of vocalising and prespeech (fig. 4). Some gestures are more often combined with 'big' open-mouthed expressions or calls like those adults make in greeting or attracting attention, or to express excitement, surprise or anger (Darwin 1872; Eibl-Eibesfeldt 1970; Ekman & Friesen 1969). This category includes vigorous hand waving and large open-handed or fistled movements. In contrast, index-finger pointing and finger-thumb closing with the hand held up over the shoulder or near the face are often synchronised with the climax of prespeech and the formulation of a new focus for visual attention (fig. 4). The association of lip-pursing or tongue protrusion with index-finger pointing or index-thumb closing, and of open-mouthed calling with wide open hand recalls Peiper's concept of 'spreading' of movements between eyes, mouth and hand to produce a pattern of simultaneous opening or closing (Peiper 1963). But the combinations are far too numerous and subtle for this to be a satisfactory explanation.

By the second month infants show improved visual focus and their eye movements communicate the changing direction of their visual attention. A two-month-old can elect to look at things of interest and can reject or avoid by looking away. Systematic eye movements to or away from the hands and face of a partner, especially to the eyes or mouth, are important signals in person-to-person interaction (Caron et al. 1973; Maurer & Salapatek 1976). The fact that infants select organs used for expression (eyes, mouth, hands) as foci for attention suggests that looking is a pre-adapted response to particular signal patterns (fig. 5). Eye-to-eye contact has been used as a defining feature of face-to-face communication between young infants and others (Robson 1967; Stern 1974b). The development of deliberate well-aimed visual orientating to the mother's eyes when the infant is about six weeks old is the main event of which she is aware at the start of 'strong' communication (Wolff 1963; Robson 1967). At six to eight weeks focussed looking with knitted brows giving way to smiling and prespeech are clearly differentiated in an intelligible and appealing

pattern of communicative intent (Rheingold 1961; Stern et al. 1975). Even blind infants orientate to faces. They are well coordinated when they direct their eyes toward voices as well as when they link aiming the eyes with head rotation and attempts to reach and grasp. Blindness easily goes undetected in early infancy because looking movements seem normal (Freedman 1964; Fraiberg this volume).

The whole complex of actions just described seems to imply that the infant has a clear commitment to intentional communication. But do infants adjust their expressions in relation to other people or are their different expressive movements entirely the result of changes in a vague protocommunicative state, one that is pure output stimulated by recognition of a face but is blind and deaf to signals from communicative acts of persons? To answer this question we must examine the sensitivity and responsiveness of infants to signals from people who desire to communicate with them.

3 Infants adapt to expressions of the mother

Young infants respond adaptively to a wide range of human signals and these responses demonstrate their elaborate perception of persons.

Infants mimic expressions of adults. Maratos (1973) has shown that infants under one month of age may imitate pitch and duration of sounds, tongue protrusion and mouth opening, but she did not obtain imitation of head rotation, babbling or leg displacement at this age. Meltzoff & Moore (1977) report discriminating imitation of hand gesture, tongue protrusion and jaw drop with open mouth by neonates. I have observed that infants in the second month may imitate hand opening or bringing the two hands together. Piaget (1946), in his careful study of imitation, without the aid of film or video, underestimated the initial imitative competence of infants. When reproducing tongue protrusion or a voice sound even the one-month-old infant shows signs of searching for the right effect, making repeated responses with variations. The search for a desired pattern of movement must be regulated by a process of matching. It does not necessarily depend on body sensations caused by movement of the limbs or face or comparison of the 'image' of a movement to be made to that of a movement seen must be taking place in the brain. In order to imitate, the infant must have a cerebral representation of persons.

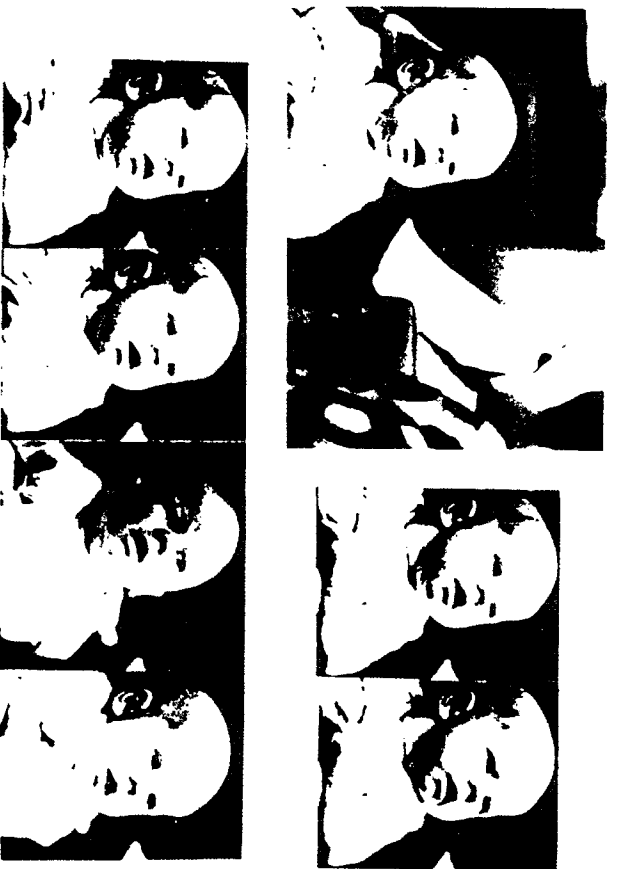


Fig. 5 Girl (6 weeks) spoken to softly watches face intently, brow furrowed and mouth open, then stits and makes start of prespeech.

Maratos (forthcoming) found that imitation of facial expressions and simple voice sounds declined in the second to fifth months. Deliberate and more accurate reproduction of babbling and crying sounds after thoughtful watching appeared in the fourth and fifth months. Piaget (1946) described similar regulation of imitative accommodation. Observations by Uzgriris (1972) confirm that a more deliberate manner of imitation of expressive movements and vocalisations is characteristic of infants of five months or older. On the basis of my own film data I have called the early form of imitation 'magnetic' and the later 'discretionary' to emphasise the increased deliberation (a more developed self-awareness?) in the second period (Trevarthen 1978).

All movements imitated by infants resemble movements they may formulate on their own. The models offered are themselves imitations of babyish acts (Piaget 1946). Imitation is certainly not passive incorporation of 'new' experiences; it is more a remodelling and integration of components already in spontaneous expression. Therefore, the fact of imitation gives no licence to an unqualified empiricist approach to the growth of communicative abilities in man. It merely suggests how

the infant may pick up new variants of expressions in collaboration with adults (Trevarthen 1974c).

To imitate, an infant must discriminate the model expression, but more cogent evidence that two- to five-month-olds perceive expressions is the subtle way in which the baby *translates or complements* the mother's acts. Even when not imitating, infants in our films show sensitive and specific replies to the communications of their mothers. A smile may elicit a call or a wave. Raised eyebrows may elicit a smile. Frowning may cause the expression of surprise, fear or even sudden crying. The temporal correlations between behaviours in such exchanges have recently been emphasised by authors who describe the 'interactions' of 'rhythmical' and 'cyclical' in a 'communicative network' or 'dyad' (Brazelton et al. 1974; Lewis & Freedle 1973; Schaffer 1977b). Imitation is evidently a special case of intersubjectivity mirroring (Trevarthen 1974c; Sylvester-Bradley & Trevarthen 1978).

The reaction of an infant of three or four weeks to the approach of an adult and to speech and touching is orientation to the face with gaze fixed on eyes or mouth, facial expression of interest or mild surprise (wide open eyes, brow 'knitted', everted lips, mouth slightly open) and smiling (fig. 5). Experiments with artificial stimuli show that even neonates prefer to look at simplified face-like patterns (Fantz 1963). They seem to explore the configuration of the face, being most attracted to the eyes (Lewis 1969; Carpenter et al. 1970; Wolff 1963, 1969). They are more interested in upright faces (Watson 1972), which adults also see more easily. Experiments show that looking to faces and preference for looking at eyes increases in the second month and is usual thereafter (Caron et al. 1973; Maurer & Salapatek 1976). Infants discriminate colour, evidently by means of built-in categorisation of wavelength into a code of the primaries: red, yellow, green, blue (Bornstein 1975). Light reflected from the skin of humans of all races is reddish. This may explain the preference infants show for a patch of red in a non-red field, a preference which could aid them in finding a face or hand. Two-month-olds will try to communicate with a televised image of a human face and this permits many experimental manipulations and tests of their understanding of communication behaviour (Papoušek & Papoušek 1974; Murray forthcoming).

Perception of human sounds is acute in very young infants. Speech is reacted to with particular interest. The pitch characteristics of the

voice are preferred to non-voice sounds, and the female voice is preferred to the male (Eisenberg 1975). There is evidence from sucking tests based on operant conditioning that by one month consonant formant transitions³ in synthetic speech sounds are distinguished (Eimas et al. 1971; Trehub 1973). The mother's individual voice or manner of speaking is recognised and preferred early (Mills & Melhuish 1974).

Finally, the strong response of a newborn to the periodic motion of an object in an otherwise inactive field must contribute to his perception of persons and their communication signals. All voluntary movement is periodic (Bernstein 1967). It has rhythmic coherence, a hierarchical structure of cadences and a strong tendency to synchrony of beats. Movements of different parts of the body demonstrate 'self-synchrony' (Condon this volume). Condon & Sander (1974a) have presented evidence that the speech sounds of adults may act as pacemakers for limb movements of listening neonates. It is possible that the neonate becomes locked into adult speech, but much of the periodicity observed in limb movements of neonates is contributed by the infant's own motor pacemakers (Trevathan 1974b). I believe that they are less passive in their entrainment than has been suggested, and doubt that synchronisation of this kind contributes to the development of language.

We find that close integration of rhythm of mother and baby is one of the clearest features to emerge from microanalysis of happy communications between two-month-olds and their mothers (figs. 7, 8 and 10). Coordinated action with synchronisation about a common beat is the framework on which reciprocal exchange of complementary messages is based (Brazelton et al. 1974). Two-month-olds can stop and start activity, a capacity which is essential for reciprocal exchange. Reply movements by sound making and gesture may extend the same beat as the baby talk of the mother and the head and face movements or touching which accompany her speaking.

When adults are unresponsive, avoiding or aggressive, two-month-olds show tension or distress by facial expressions of fear, yawning, grimacing and frowning, as well as by gaze avoidance, crying, startle movements and thrashing or struggling. L. Murray in my laboratory has used an interruption of communication to test the predictions of the infant about communication (Murray forthcoming). Mothers are asked to stop reacting and to freeze their expressions for one minute in the middle of a happy communicative exchange. The infants give

complex emotional responses. They may move as if to shout with sudden waving of the arms and grimaces of excitement while staring at the partner's face. These appear to be acts of appeal or solicitation. Brazelton et al. (1975) report the same results from interruption of exchanges with mothers, and Papoušek & Papoušek (1975, 1977) have studied the cognitive basis for distress when the infant is confronted with maladapted or artificially distorted maternal signals.

These reactions prove that an eight-week-old may respond predictably to unfriendly actions from a familiar person (Tatam 1974; Murray forthcoming). Signals of distress or protest include self-stimulatory, avoiding and aggressive acts, like those of children who have been chronically isolated from human contact or who are diagnosed as autistic (Clancy & MacBride 1975).

The signs of anxiety and distress when communication is broken show the close integration of subjective emotional states with interpersonal communication. They also show how the infant may move to recover communication if the mother fails to display affection. The infant makes forced, abrupt and large gestures which attract attention, then shows passivity and sadness or grimaces and gestures of distress which stimulate comfort and concern. In a test of the infant's intermodal perception of the mother, Aronson & Rosenbloom (1971) found that one-month-old infants made complex expressions of distress, including crying, when loudspeakers were placed to create an artificial separation between the perceived location of the mother's voice and the location of her face seen through a window. This observation is consistent with what we have seen after disruption of communication.

The infant is clearly equipped to perceive and interpret input from the mother's personality. Indeed, adaptive forms of reply to what the mother does give the infant a considerable control over the communicative exchange from the start. On this base learning will later permit the infant to achieve much more elaborate expressions and more subtle recognition of the mother, adding strength and content to their growing affectional and communicative attachment.

4 The mother generates expressions adapted to her infant's interest

Our mothers were skilled human communicators. All those who agreed to participate had busy lives. Most were married to men with pro-

fessional or intermediate classes of occupation and the majority had at least secondary school education and were fluent in spoken language. Our films show that individual mothers differed in the style or range of their expression according to their personalities. Nevertheless, all made the facial expressions and gestures of surprise, amusement, anxiety and so on. Each mother mixed the pan-human language of expressive communication with socially cultivated mannerisms, and with speech that varied widely in content.

There is great richness and variety of structure in adult-to-adult communication, and the infant could conceivably be equipped to respond to some of it at least. However, it is not the adult forms of communication in the other's behaviour to the infant which interest us most, but a special manner which most of the observed mothers developed for capturing the infant's interest (Papoušek & Papoušek 1977; Stern 1974b; Snow 1972; Sylwester-Bradley & Trevarthen 1978). Differences in playfulness, sensitive encouragement and contingent pacing of mothers in the home when the baby is three months old are prognostic of the quality of the relationship (security of 'attachment') when the baby is nine months old (Blehar et al. 1977). Clearly there is an optimal adaptation of the mother to the baby.

As soon as a mother begins to talk to the baby her movements become regular and subdued. She speaks more quietly and more gently and becomes highly attentive, spending as much time waiting and watching as speaking. The form of speech is changed in consistent ways towards the regularity, repetition and musical, questioning intonation known as 'baby talk'. Alternatively, the mother may become active and playful, or teasing; making rhythmical and exaggerated movements of her head, trunk and whole body, or reach to touch the infant in emphatic ways. When playing in this way she tends to use nonsense sounds. In visible records of the sounds of baby talk the overall effect is that of repeating patterns as in simple music. Apparently baby talk is regulated to create short dramatic episodes of action, with controlled change of intonation to a short succession of marked climaxes. The same may be said of the mother's playful movements of the head and face, of her touching with the hands and of her singing or nonsense syllables to create voice games. It is probable that baby talk obeys unconscious rules of expression, and that these rules are also applied automatically through the whole range of expressive movements whenever communication is attempted with

any being that is conceived to have limited comprehension. The manner of baby talk is close to that sometimes used in speech to animals, foreigners and mentally defective or extremely aged persons. However, I do not believe that simplification is the main purpose of baby talk. A solicitous or caring intent, leading to watchful gentleness, seems more fundamental. It is a specific, assisting form of intersubjectivity, and not simple at all.

In general this automatic adaptation of a mother's behaviour would seem to match infants' perceptions and communicative capacities. Papoušek & Papoušek (1977) consider the mother's baby talk and associated orientating and patterned body movement to be highly adapted to the cognitive, learning and information processing competence of the infant and to give strong support to the initial development of cognition. Most mothers, even when unaware of doing so, tend toward similar patterns of rhythm and repetition. This behaviour of mothers, closely fitted to the baby's needs, makes it possible for the investigator to use baby talk and vocal games to detect infant behaviours which indicate changes in communicative intelligence (Sylwester-Bradley & Trevarthen 1978). It also offers a sensitive way of comparing the communicative styles of mother-infant pairs. This aspect of intersubjectivity with infants, in spite of rules that transcend cultural groups, varies widely in certain details between different individual mothers, and these differences show marked correlations with social class (Blehar et al. 1977; Moss et al. 1969; Lewis & Freedle 1973; Stern 1974b).

In a very few of our recording sessions the mother was unable or unwilling to submit to the special requirements of communication with a young infant under laboratory conditions. Then her infant was fretful or avoiding. Individuals less experienced or less involved with an infant than the mother may likewise fail in communication. This is because they fail to support the infant's expressions of pleasure or his prepeech and gestures. It is important to note that our method using staged communicative exchanges in an institutional environment may intimidate the mother, the infant or both and cause a breakdown of intersubjectivity or its change to a distressed form. However, it does not take much observation in homes to determine that 'normal' human communication with infants is very varied in quietness and success. The 'studio' situation does not appear to be outside the range of natural interactions. Even in the home and under optimal conditions the mother has to adapt deliberately to her infant to obtain

communication. These observations of failure in communication give strong support to the claim that both infant and mother are sensitive to the quality of each other's expressions.

5 Mothers respond to the expressions of infants

The films show that mothers are captivated and emotionally involved with their infants (fig. 6). As soon as the infants join in communication the behaviour of most mothers quickly becomes subdued and attentive to and dependent on what the infants do. In our films mothers are usually watchful and questioning or show signs of surprise or disbelief. They react as agents who are subordinate to acts of babies. Smiling, baby talk, touching and moving the face in and out



Fig. 6 Mother mirroring 2-month-old daughter (from cine film). Left, top to bottom: they smile, then the infant makes an utterance with gesture; right, top to bottom: at the climax the infant is not smiling, the mother initiates calling out with mocking exaggeration. Interval between climaxes of expression of infant and mother = 1 second.

towards the infants cease, and are succeeded by attentive stillness and orientation to the infants' faces, and by imitation of certain infant expressions.

In the communications we have observed, close imitation of the infants by the mothers is characteristic (figs. 6 and 7). The imitated behaviours, often reproduced with playful exaggeration or gentle mockery, include excitement and vigorous calls. Mothers imitate tossing back the head, raising eyebrows in surprise or emphasis, opening the mouth, frowning and laughing. Some mothers include conscious or semiconscious humorous, sometimes teasing or aggressive, reproductions of comical expressions in their imitations, including poking out the tongue or grimacing (fig. 6). But most of the imitation in our sample is unconscious following of the infants' most vigorous or most prominent gestures. The behaviour may be described as mirroring, although, since it is often slightly after the infant in time, 'echo' describes it better. At other times, mothers synchronise with or even slightly anticipate what infants will do. Reflecting excited or melo-

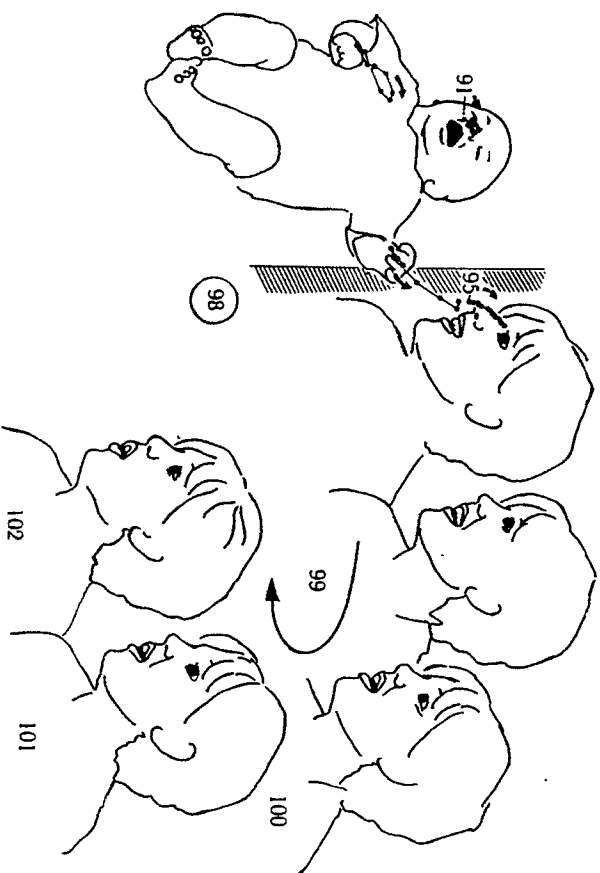


Fig. 7 Imitation with close following of boy (12 weeks) by mother. Infant moves head and vocalises; 4 frames later (= ¼ second) mother moves head back to exclaim in reply. (From cine film; same episode as fig. 10, to which frame nos. refer.)