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5 What infants' imitations communicate: with mothers, with fathers and with peers

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Imitative reactions, sympathetic emotions and human learning

If we observe children closely, we see that culture is propagated, not so much by training in skills, as a 'behaviouristic' theory assumes, nor even by instruction putting knowledge into human information stores, but by learners' and teachers' active mimicry. However it is cultivated, institutionalised and managed, education of culture is a conversational, intersubjective process in which the learners make active contribution.[1]

Everyday life in human society is animated in *mutual interest between persons* who, in their conversations, and depending on their status and companionship, express reciprocity of intentions, interco-ordination of skilful movements, convergent imaginings and conscious recognition. All human communities and societies are like this, however different they may be in size, structure and technical sophistication, and in whatever form the history of their knowledge and beliefs are coded, stored and transmitted. Reasons and explanations, facts, institutions and powerful roles are attractive and explored because human individuals find them potentially of interest to other human beings. They are social knowledge produced by interaction (Barnes, 1995). It follows that the 'context', 'content' or 'construction' of a culture, its ethnography and its language, cannot be the cause of its meanings. Meanings come from the human need for individuals to communicate interests, purposes and feelings. This requires a psychological means of representing knowledge in sociable forms, and even infants have the rudiments of this ability (Trevarthen, 1994). *Mimesis*, the ability to mimic or 'become' objects, natural events, animals, human purposes, remembered actions of other persons, even fantasies that go beyond possible real experience, to represent experiences for oneself and to others in metaphorical simulation, has, in fact, been identified as the defining feature of the first evolutionary step to the human level of mind (Donald, 1991). Mimetic behaviour, called fantasy play, is also the driving force of learning in

early childhood. Victor Turner (1982) called it 'the human seriousness of play'.

Human imitative 'acting out' is done with *emotions* that respond immediately, open to the real or imagined gaze of other human beings – emotions that can make and break relationships of trust. Sometimes we display painstaking 'conscientious' deceptively self-centered concern. But, if failure threatens, our self-confidence may be clouded by shame, fear or anger. Often we imitate in a confident happy way with infectious exuberance and *esprit*, and when this joy is shared it strengthens companionship. The need for display of evaluative emotion distinguishes imitations between persons from all other accommodations each of them may make as a rational subject who bends purposeful activity to the constraints and opportunities of the impersonal or indifferent physical world. There is no point in showing emotions to things, except as part of the game of being an imitating and imitated actor in the human world. Imitations have a communicative purpose, and they attend to human evaluations of their motives.

A capacity to imitate instructive models or exemplars has always been regarded as important in education of the young and formation of a socially approved character and intelligence. None the less, human imitation, especially that of unsophisticated infants who are too young to follow explanations, remains problematic in a psychology that concentrates most of its effort on measuring the rational, cognitive functions of the minds in single adult subjects. Imitative behaviours still evoke intense theoretical controversy. Intersubjective, 'other-sensitive' imitation of actions, roles and narrative displays is typical of infants and toddlers long before they master language. Newborns are willing and selective imitators from the first contacts they have with the expressions of other persons. We use imitations interactively to motivate one another reciprocally from the start. These earliest imitations offer the greatest challenge to psychological theory.

We begin an account of this fundamental human psychological characteristic in terms of the *theory of innate sympathy* developed by Adam Smith (1759), the Scottish philosopher of society and morals (who was much more than the father of market economics). Smith saw that imitations are sympathetic responses, and to explain this he described how persons watching a street gymnast treading a high wire tend to move their bodies as if participating in the balancing. In his account, as in that of his teacher in Glasgow, the theologian and moral philosopher Frances Hutcheson (1755), sympathy is clearly qualified by *emotion generated by others' attitudes*. For example, Smith defined the moral conscience as the 'impartial observer' who may criticise one's acts, conveying feelings of

approval or disapproval. We are inhabited by a kind of internal imitator who can make judgments of the good or bad nature of our actions. Thus Smith believed that each person can assume at least part of the feelings, purposes and judgments of others, different from his own. Imitation of a behaviour appears to be *one* kind of response in this sympathetic relating, among many. Imitating has many functions, depending on the give and take of the interpersonal transactions, and the rise and fall of trust and understanding in relationships, and depending, too, on the level of cognitive representation at which it is operating.

What is imitated?

In modern psychological terms, sympathy could be defined as the mutual elaboration of behaviours by individuals who match their separate dynamic cognitive images, judgments and memories. They construct models, schemata or representations of one another and the world they know, creating matching patterns that can be recreated and stored. But the notion of a cognitive scheme or process, or any acquired representation that assimilates and remembers perceptual information about the effects of acting in a particular way in the past, is not sufficient to explain how *the intended act itself* can be perceived and immediately imitated, as it often seems to be, without practice and trial and error. How could an *intention* pass at the first occasion from one person to another? We will defend the hypothesis that *endogenous motives* or 'images of action', which are at the source of all intentions and of the recognitive processes that assimilate perceptions to guide and regulate what is done, must be taken in directly, and reciprocated or 'reflected back', for sympathetic mimesis to begin. Our task is to explain how this could be, how behaviours and their motives can be translated intersubjectively. Our psychology offers little help. It gives us no clear explanation for fundamental motives, or for their intersubjective transfer. The emotional forces of human semiosis, correspondingly, remain obscure.

The facts are that motives in individuals do affect the awareness and intentions motivated in other individuals. The understandings (and misunderstandings) of talk, and of all symbolic and representational forms of language, are carried upon intuitive interpersonal regulations, and upon mimetic representations that cross intersubjective space easily. They are woven into narratives of sympathetic intentionality charged with emotions. We believe that research on how, without being able to speak, infants begin communication, and how they develop a capacity to share understanding of what they and other persons mean by what they do and by what they say, can give essential information. The evidence has been

coming in over the past three decades from research on infants' interactions with other persons, and especially from detailed analysis of what expressions infants are sensitive to and how they move in response. The protoconversational reactions of infants about 2 months of age (Bateson, 1975, 1979; Trevarthen, 1974, 1979) show that humans have a dual representation of self and other that permits them to enter into immediate relation with one another's emotions in 'dialogic closure' (Bråten, 1988, 1992). Such a capacity is evident immediately after birth.[2]

Within the first year, an infant gains understanding of meaning in 'co-operative awareness' with 'joint purpose' (Bakeman and Adamson, 1984; Bretherton, McNew and Beeghley-Smith, 1981; Bruner, 1976; Hubley and Trevarthen, 1979; Scaife and Bruner, 1975; Trevarthen, Murray and Hubley, 1981; Tomasello, 1988). This is a new and striking change in the infant's motives, which we described as the development of 'secondary intersubjectivity' (Trevarthen and Hubley, 1978). It involves the infant in active co-ordination of his or her (praxic) interests in objects with the directions of attention and the apparent intentions of a partner who becomes a companion in task performance (Hubley and Trevarthen, 1979). These terms imply both an interest in 'reading', and representing, others intentions from their attentions, gestures and expressions, and a capacity for mimesis, if this is defined as the matching of motives between individuals who reflect one another's social affordances and dynamics of thinking, and a transfer of ideas about what the motives intend to do (Donald, 1991). A 1-year-old will use this new understanding to aquire many ways of acting that demonstrate deferred imitation of others' purposes and meanings (Meltzoff, 1995; Trevarthen et al., 1981; Trevarthen, 1990).

We do not believe that the conversational and imitative ability of infants comes from learned intermodal associations between feedback effects of moving, nor do we believe that the primary function of imitation is to establish emotional coherence and self-awareness, or to identify who other individuals are, though both these acquired understandings, and many others, can be explored and elaborated in reciprocal imitation games. Some direct *intermotive attraction* is involved when imitations occur. This is manifest in the ability of newborn infants to communicate, including their ability to attend to and *complement or copy*, eye contact and a variety of facial, vocal and gestural expressions. It is important that the behaviours which newborns imitate are specifically adapted in their form and timing to guide interpersonal motive transactions. Facial, gestural and vocal expressions are inherently richer in humans than in any other species. They equip the infant as a potential partner in dynamic emotional narratives. The immediate appearance at birth of this conversational interest means that its mechanism must reside in brain systems tha were organised to be regulations of such experience before birth, i.e., i adaptive anticipation.

Constitutional foundations for imitation of motives

Seeking for a unified psychobiological theory of how imitation is possible for any sentient and active organism, we first define motives as spontaneous processes generated in the interneuronal core of the brain that result in *motor sets*, on which are built both co-ordinated movements and coherent perceptions to fit the movements to surroundings, prospectively. On the one hand, the effect of these sets is to direct initial co-ordinations between efferent neuromuscular outputs – to produce acts that aim the body in adaptive patterns and directions of movement. They are also inseparably coupled with *perceptual sets* that ready the afferent and cognitive brain systems for certain act-related inputs of information (affordances) that may guide the movements once they are made, increasing their efficiency and efficacy (Gibson, 1979; Neisser, 1976; Sperry, 1950, 1952; Von Holst and Mittelstaedt, 1950). Perception informs 'prospective control' for the actor's moving (Lee, 1993).

Figure 5.1 presents a summary of the place of motives in the generation of action and perception. Motives (M) organise *act intentions* (A) and *perceptual attentions* (P) as one adaptive process. The set of motor initiatives (m) that activate *sensory-accessory muscle systems* (a), which orient, focus and modulate pick-up of information by the special receptor systems of the head, eyes, ears, mouth and hands, are of special importance in communication of motives, because they offer advance information about what the actor is *becoming interested in* or is *going to do*. They make motives apparent.

'Motor images' can be detected in the brain in the form of neuronal activity that precedes a movement and perception, and they are also evident from the intrinsic programmed characteristics of movement. In a recent review of the evidence from neurophysiology and experimental studies of behaviour, Jeannerod (1994) concludes that, in what he calls the 'representing brain', 'the content of motor representations can be inferred from motor images at a macroscopic level, based on global aspects of the action (the duration and amount of effort involved) and the motor rules and constraints which predict the spatial path and kinematics of movements'. In other words, the brain represents, in one integrated time–space field, the *rhythm*, *effort* and whole-body-related *direction* of moving, and starts to do so before the execution of any act, predictively. These are generative features of brain activity and movements.

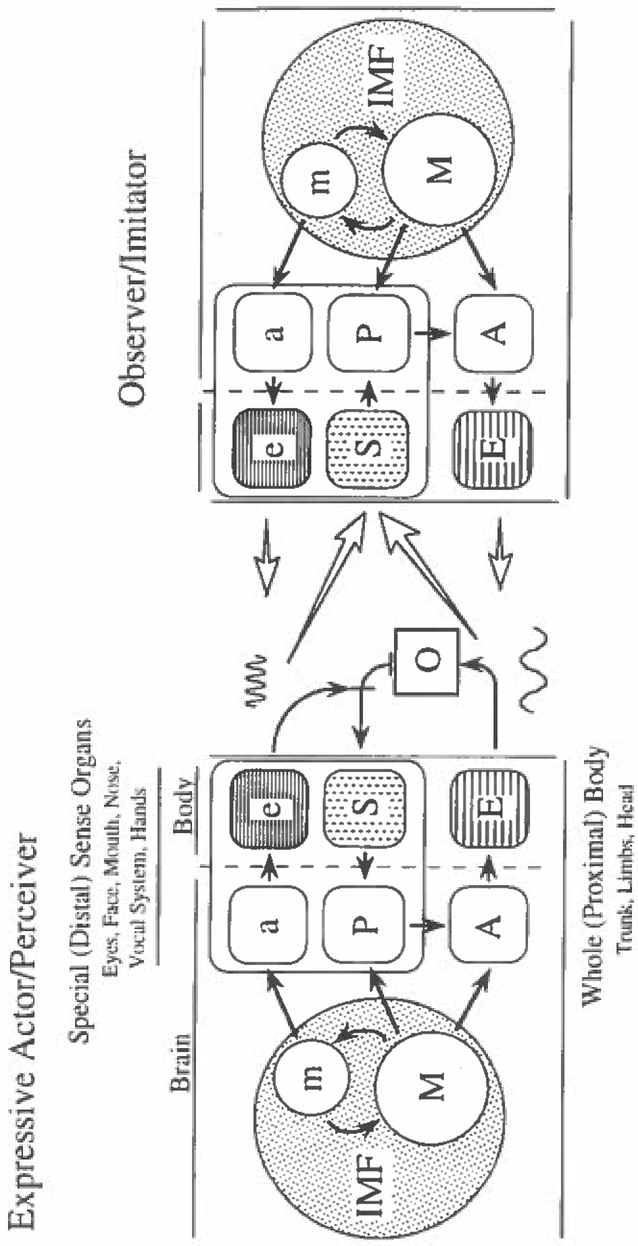

Figure 5.1. Motives are generated in the core of the brain in an interneuronal system, the Intrinsic Motive Formation (IMF). This co-ordinates all neural centres in one generative space–time field of behaviours. Motives to move the body (M) integrate mechanisms of perception (P) and action (A) in cycles of perceptuo-motor activity that are performed by effectors (E) and monitored by receptors (S). A subset of the motor system (a + e) is motivated (m) to regulate the orientation and focusing of special sense organs. Effector activity may make use of objects (O) and at the same time transmit rhythmically coherent effects that may inform the motives of an observer or imitator, who has similar (sympathetic) motive principles, about the purposes, interests and feelings of the actor.

In the puzzle of imitation, it is of great interest that activity of a group of prefrontal neurone units in the brain of a monkey that appears to formulate the motor image for a particular act of manipulation (an m-system output, Figure 5.1) has been shown to be excited when another individual, for example the human experimenter, is observed by the monkey to be making *the same manipulation with the same preparatory hand positioning* (Di Pelligrino, Fadiga, Fogassi, Gallese and Rizzolatti, 1992). 'This very striking result supports the idea of representation neurons as a common substrate for motor preparation and imagery' (Jeannerod, 1994, p. 190). It also shows that, with appropriate body-to-body mediation, neurone activity in one brain can *imitate* neurone activity in another brain.

Motor images may also be inferred from biomechanical analysis of the organisation, economy and efficiency of forces in the body when it is moving about or acting against the environment. They may be inferred to form an essential purposeful component of organised neuromuscular events (the forces and their transitions in 'biodynamic systems' of the body) upon which all skilful movements depend (Bernstein, 1967). As with the electrophysiological indices of the aim and form of the monkey's manipulations, the economy and harmony of movements and their generative impulses can be 'read' by another voluntary agent directly. Indeed, human observers are remarkably good at detecting the effort or rhythmic grace of another person moving, sensing their comfort or pain. An observer can perceive a whole moving body from fragments of information about the coactive displacements of joints and segments of limbs of persons walking, running, dancing, picking up objects, etc. (Johanssen, 1975; Runeson, 1977). For example, we can see the human body in a display of spots of light that are attached to the limbs of a walking or dancing person who is observed in the dark, and it is even possible for us to identify a familiar person from the way the lights move.

As shown in Figure 5.1, the m-component of motives makes preparations for effective action – it *attends to (directs) perceptual exploration (investigative behaviour)*, employing both distance and surface receptors. The *special accessory motor systems*, for looking, listening, palpating, sniffing, tasting, get detailed perceptual information about goals for more general and more definitive action, *before* irrevocable commitment is made by displacement of the whole body. The ethologists long ago distinguished these two stages of motivation by their manifestations in 'orienting' and 'consummatory' behaviours (Craig, 1918). At the same time as orienting of reception is taking place, motives estimate the potential effects of behaviour inside the body. The *self-regulatory emotions* assess and define the 'pleasures and pains' and 'benefits and risks' of acting *for the organism*, and make appropriate anticipatory adjustments in the physiological systems of

the body. In a behaving animal, activity of the heart and respiratory organs is adjusted appropriately, again *before* muscular activity is excited (Jeannerod, 1994, p. 192). Thus, in dealing with situations and objects, the sentient and voluntary subject is both selectively orienting to pick up information in an array of receptor modalities, and readying the physiology of the body for action. Because the affordances of objects and circumstances differ, they become associated with differing 'aesthetic values' or *object-related emotions*. Intentions are projected in orienting and preparatory movements adapted to the location, form, size, etc. of the object, and expressions of feelings about the object's uses or properties accompany this phase of purposefulness. Finally, the anticipatory activities of the brain/mind, their rhythms and externally detectable patterns, are potentially important sources of information for another subject who needs to interact with the one whose motives are changing. Human facial and vocal expressions of *interpersonal emotions* have evolved from these early signs of purposeful action (Buck, 1984; Darwin, 1872; Izard, 1971, 1980). These emotions about and for persons are not just for self-regulation; they are the natural source of 'moral values' in 'self–other' relationships. Thus may be defined three facets of orienting and emotion, depending upon their functional aim or purpose; related, (1) to the body, (2) to physical circumstances or objects, and (3) to persons (Trevarthen, 1993a).

Antenatal developments

If we wish to imagine how a newborn brain could be equipped with this constellation of intrinsic behaviour-regulating mental powers that predict an active existence of the body in interaction with objects and other individuals, we can invoke the classical embryological principle of 'prefunctional morphogenesis', assuming that a mechanism for motives and emotions formed in the embryo, which is prefunctional in relation to psychological activity, will constrain and organise all 'emergent' processes and representations that neuronal nets acquire as a result of stimulation from the world.

Given recent attention to the generative powers that, in theory, can be attributed to epigenetic 'dynamic systems' between body, brain and environment that come into action only after birth (Fogel and Thelen, 1987), it is necessary to emphasise that, in the 'complex adaptive system' of an animal, prenatal brain and body development, and especially development in the brain that has already set up important body-mapping and body-motivating conditions before birth, are ready to 'investigate' effects of acting, seeking purposeful co-ordination in the body and beneficial goals in the environment, selectively. A famous

example in peripheral anatomy is the eye, which, formed as a potential optical sensing device before there are any visual inputs, remains the organ for pick-up of information from light throughout life, scanning the prospective space for behaviour in intermittent steps with systematic brain-directed precision. In many animals, and most notably in humans, the eye is also simultaneously an organ of expression and of imitation, and, with a highly visible white schlera, it is anatomically adapted for this function as well.

In the brain, cells first interact and become organised in systems of neurons in the immobile body of the embryo, out of contact with the sensory receptors. The 'chaos' that a vast overproduction of neuroblasts, axon outgrowths, dendrites and synapses is assumed to create in the cortex and elsewhere in the brain of an infant (Changeux, 1985; Edelman, 1987) is deeply and productively constrained by structures and processes of brain tissue and body that were already elaborated in the embryo brain stem before any part of the nerve net was electrically active or receptive to the environment (O'Rahilly and Müller, 1994). Selective retention of neuronal assemblies that have been favoured in a competition for trophic substances or effects of stimulation from the environment postnatally is neither random nor passive. The embryo brain contains an interconnected set of ordered representations of the body's form before sensory motor nerves are formed. The 'initial state' of neural organisations in the fetal mind/brain, and their continuation as functions of an Intrinsic Motive Formation (IMF) in the brain of the child, are fundamental in all future behavioural adaptations and learning, including the elaborations in humans of symbolic thought and of language (Aitken and Trevarthen, 1997; Trevarthen and Aitken, 1994). The IMF is represented in Figure 5.1 as the integrative matrix of the CNS in which consummatory and investigative motives (M and m) are formulated.

We look to research on infants to clarify how initial, prenatally active, embryogenic motive states assist in the emergence of skilled mimesis and the generation of mimetic meanings. A first step will be to make an accurate description of intersubjective or communicative interactions of a non-verbal and emotive kind between young infants and their adult caregivers. But it is also necessary to see the antecedents of human mimesis in the imitative behaviours of many animal species.

Evolution of imitation by motive reflection of mirror affordances

Social co-operation between even the simplest animals requires recognition and co-ordination between motive impulses in different individuals.

In the least elaborated forms with rudimentary brains there is little mental activity to transmit, just periods of restlessness and the present direction of moving. Matching sensibilities and ways of locomoting allow environmental events and simple non-psychogenic signals (for example, gravitation, the fluctuating heliocentric field of light, or chemical markers) to serve as an immediate frame for parallel action, as when plankton swarm on the surface of the ocean on one night with a full moon, or ants or moths follow the same pheromone trail. But, even in molluscs, insects and lower vertebrates, there is some recognition by individuals of the correspondence between the motives of the perceiver and perceptible features of *body form or rhythm* that motives regulate in other actors. Sign stimuli embodied in animals' surface features coupled to the ways they move the body or its parts elicit specific reactions, and are invited by complementary specific signalling behaviours of social partners (Lorenz, 1965; Sebeok, 1990; Tinbergen, 1951). With this degree of intersubjective recognition, more complex imitative and complementary reactions, and more subtle social learning, are possible.

Imitating animals pick-up signals of their partners by the same collection of modalities that they use to guide their locomotion, or to project their movements to fit objects in the environment. Visually driven imitation has been assumed to be more difficult to explain than the more self-stimulatory effects in audition or vibration sense because it can be imagined that in the latter case the model's behaviour is experienced *in the same form* as the imitator's reproduction. This, however, is a misconception. Even auditory signals are different for the emitter, who hears them through the body and inside the head, than for a distant perceiver. Moreover, the body of the former is moving to make sound, and is, therefore, making other proprioceptive inputs as well. Visual imitation is not, in reality, the most esoteric form of behavioural mirroring, and it is common in animal social life. Many species with small brains but efficient sight not only guide their actions by reafference feed-forward mechanisms, but also imitate actions they see in other individuals. For example, Siamese fighting fish display to a mirror, becoming excited to fight the reflected image. Jumping spiders court their mirror-image.

Translation between the affordances of *proprioception* ('self-as-agent' feeling) and *alteroception* ('other-agent' feeling) always requires intervention of some mechanism of intersubjective closure to affirm a correspondence or matching. This could be called 'affordance mirroring'. Each subject's actions to perceive or make use of what the partner affords become affordances for the partner. 'Constancies' in perception take origin from the impulse to act in the form of 'corollary discharges' (Sperry, 1950) or 'efference copy' and 'reafference signals' (Von Holst and Mittelstaedt, 1950). This same trace of an impulse to act could be used to detect acting by another individual.

In birds and mammals, rhythmic invariants in other individuals' acting and differentiated forms and surface adornments of body parts are reacted to in specific ways, and moves of one individual are often repeated by partners. This is equally true for both *orienting or exploratory movements*, on the one hand, and for *consummatory acts* that are aimed to use objects in the environment in particular ways. Many of the orienting movements, as *intention movements* (Tinbergen, 1951), have become specialised as predictive expressions of motive energy or emotion to which conspecifics are ready to respond. Exchanges of intention movements evolve into ritual displays and routines of interaction in which the motive states of participants are transformed, to aid mating, feeding of young, collaborative foraging, etc. Reptiles, birds and mammals transmit socially important messages of purpose or feeling to other members of their group by means of postural, gestural and vocal signals (Marler, Evans and Hauser, 1992; Ploog, 1992). In species of birds and primates with high social intelligence there is a powerfully developed insight into the rhythm and directedness of group members' mental processes picked up from what they do. They manifestly share, and imitate, intentions.

The primates, and especially the apes, with their extraordinary manipulatory intelligence and uniquely developed focal visual assessment of surroundings with precisely co-ordinated saccadic eye-and-head movements, are capable of highly discriminating imitation of acts that exploit environmental resources (Byrne, 1995; Galef, 1988; Gomez, 1991; Visalberghi, Fragaszy and Savage-Rumbaugh, 1995). They also imitate the gestures their partners make, and can subtly reflect or exploit social behaviours of their partners, taking account of social partners' preferences and aversions as they orient to and manipulate the environment (Cosmides, 1989; Menzel, 1971; Tomasello, Savage-Rumbaugh and Kruger, 1993b; Whiten and Byrne, 1997). The brains of primates have evolved in relation to the size, and therefore the intersubjective complexity, of their social groups (Dunbar, 1992; Goody, 1995; Humphrey, 1976; Passingham and Ettlinger, 1974). Apes can be trained to use a token system or a gesture sign system to gain social co-operation (Premack, 1987; Savage-Rumbaugh, 1986). They have a degree of connectedness and flexibility of purposes, a curiosity about the narrative gestures of their social partners and a self-consciousness of agency that goes beyond that of the monkeys (Donald, 1991; Whiten and Byrne, 1997).

It has been claimed that captive apes, like humans, demonstrate *conversational intelligence* when they repeat arbitrary coded gestures or symbol manipulations that human partners make for various co-operative

purposes in a game-like exchange (Greenfield and Savage-Rumbaugh, 1993). Even so, it is clear that sympathetic (intersubjective) awareness and conversation-like exchange of expressions have a new level of complexity and efficacy in humans. Human cultural learning by mimesis, beginning in the 'socio-dramatic' protoconversations and games of infancy, generates acquisition of an infinity of new skills and understandings, and it prepares the path to the imitative exploration of speech and the mastery of language (Clark, 1977; Locke, 1993). When other species observe and imitate intentions, demonstrating what has been called 'theory of mind', they show limitations in curiosity and goal selection. They acquire stereotyped action sequences deploying a limited repertoire of signs to accomplish defined social functions, or they learn, by imitating, how to manipulate environmental resources for immediate consumption. Human toddlers and older children, in contrast, observe, learn and re-enact social mannerisms, ethical principles, cognitive interests and investigative, problem-solving behaviour. Before they walk, they pick up, and represent to themselves in imaginitive play, elaborate routines of execution for technical and artistic use of environmental affordances for goals that are remote in time and space, goals that the community has learned over generations to invest with special value and meaning. All these purposes are assisted by intentionally supportive guiding behaviours of more experienced partners (Rogoff, 1990). They are further enriched and differentiated by language, which fixes words to the actions and objects of co-operative understanding, and to the feelings and qualities of acting and experiencing. In the first stages of language learning, imitation, immediate and deferred, has many important functions (Clark, 1977), but not so much in the aquisition of grammatical forms of expression as in the negotiation of purposes and interests, and in the exploitation of, and experimentation with, the activity of speech.

Humans live and learn by sharing the myths and rituals of a cosmos of meaning created historically and dramatically. The icons, signs and symbols by which they encode this communal awareness may or may not be taken into speech or other language. They are remembered from anecdotal moments when ideas and their expressions were shared by subtle and largely unconscious forms of sympathetic mimesis. We express purposes and convey meanings to one another elaborately, and with emotion.

How psychological theory has failed to explain human mimesis

Imitation, the transfer of forms of behaviour between subjects, is regarded in quite different ways by different theories of behavioural co-ordination

and behavioural development. As fashions in mind theory change, so imitative phenomena change in credability, simplicity and apparent explanatory importance. In the past two centuries, the psychometric and psychophysical preoccupations of empirical psychological science, conspiring with the intellectual/literate basis and clinical and ethical preoccupations of psychodynamic theory, have actually led thinking and practice in psychology away from consideration of all but the simplest innate processes of motivation, making them a problem. The newborn infant has been conceived as irrational and, therefore, psychologically empty, preoccupied with the needs for survival and striving to regulate physiological arousal, to attain pleasure and escape pain. The infant's emotions have been inferred through analysis of mental pathology in adults. They have been portrayed as generators of dissolution and pain that need external regulation (Dollard and Miller, 1950; Sroufe, 1996). More recently, positive emotions have been given more importance. Moments of coherent joy are said to be infused into the baby from a sympathetic caregiver (Emde, 1992; Emde, Biringen, Clyman and Oppenheim, 1991; Hofer, 1990; Schore, 1994; Stern, 1990). But when infants are observed responding to caregivers with calm and affectionate mutual concern, they demonstrate active emotional initiative in a great variety of expressions, and they show communicative purpose.

In the behaviourist perspective, which sought to minimise assumptions about internal representations and endogenous motives, imitation is an impossibility, except as a consequence of the elimination of random and often misdirected responses, and by the emergence of an association learned step by step between originally unconnected reflex reactions, the selection process being reinforced by social rewards because imitations are noticed and valued by parents and teachers. Discovery of the matching response is still supposed, by some, to develop by construction of new intermodal matches (Anisfeld, 1996). Similarly, in structural linguistics and the machine intelligence of cognitive theory, imitation may result unintentionally from accommodative tracking, or in problem-solving strategies from a matching of schemata or symbolic representations that are accumulated from experience. Imitations become solutions to theoretical problems of social action and reaction, or of semantics. These theories, fundamentally rational as they are, focus on the individual who is educated by the senses, and who either re-acts by moving in response to certain structures or processes in the stimulus field, or who acts in a way that will cause the sensed milieu to generate stimuli of recognisable spatial and temporal configuration. Their interest is in perception, and the processing of cognition. Internal processes are formulated as categorisations, and categorisations of categorisations, all coded as formal effects of stimuli.

In cognitive theory, the model for an imitator can be conceived as entirely artificial, as a mechanical event with no human properties. Piaget (1962) studied infants moving their mouths open and shut to imitate a matchbox that he was manipulating. But, wait! Was he not moving the box to imitate a mouth opening and shutting? This possible 'person-likeness' of his model was, apparently, overlooked. Piaget presents visual tracking of a moving object as the paradigm of 'imitation', an accommodative problem-solving activity of reason that is coupled with the expression of a *self-regulatory* emotion of 'serious intent'. This function he contrasted to 'play', which is triumphantly assimilative and performed with *self-satisfing* 'pleasure in mastery' (Piaget, 1962). Piaget was disregarding the communicative function of these displays while he minimised the role of emotions in regulations of interpersonal consciousness. His notions of the 'biological' functions that form the basis for pleasure and unpleasure correspond with those of Freud.

We conclude that the source of a subject's insight into what other minds attend to, what they intend to do and how they feel about it has been made into a mystery by reductive assumptions of how the mind reasons about, or experiments with, experience as the embodied subject regulates feelings of pleasure and pain. Recent speculations about how a 'Theory of Mind' develops in children constitute a real advance by recognising that what goes on in minds is naturally of interest to humans. But, these models have not, we believe, much clarified the problem of how sympathetic awareness begins. They merely rephrase the verbal representational hypothesis in mentalistic or cognitive science (machine intelligence) language. The Theory of Mind debate is leading to clarification of important steps in the development of human intersubjectivity after language has been mastered. However, the basic ability to imitate remains to be understood. It is independent of both linguistic and rational representations, and it is not a symbolic formulation of machine 'thinking'. Mimesis generates symbols, not the other way round. Imitation is a part of the needed explanation.

This is made abundantly evident when we see very young infants engaging systematically with expressions of motives in other individuals to whom they pay attention in highly selective ways. It is important, first, that, many months before the threshold of linguistic skills is attained, a young infant displays powers of imitative representation and conversational reciprocity of expressions far more complex than any other species of animal (Tomasello, Kruger and Ratner, 1993a). Furthermore, human mimetic abilities develop rapidly in the first year. Sharing of ritual performances that are displayed as significant artifacts, with that 'self-satisfaction' and socio-dramatic awareness of others' evaluations which

Wallon (1928; 1970, p. 173) described as *réactions de prestance*, are typical of infants' play with trusted others in the second half of the first year (Trevarthen, et al., 1981; Trevarthen, 1990). And co-operative manipulation of objects, with orientation to observe, and co-operate with the probable intentions of companions in an arbitrary task, appear months before the first word is uttered, around the end of the first year (Bakeman and Adamson, 1984; Bretherton and Bates, 1979; Trevarthen and Hubley, 1978).

By definition, an imitated act corresponds *in some degree* with the form and/or timing of the act of another individual. (It is important to emphasise that imitations are of greater interest when they are *not exactly the same* as the identified model act, because differences between model and the reproduction may constitute, not errors, but significant information in their co-operation.) The imitator must generate movement by a cerebral process that has critical elements that match those involved in the model subject's action. How could this come about? For an empiricist, this problem must be solved by finding the same pattern of stimulation in the 'model' and the imitator, unconditioned or the consequence of shaping and internalisation by a learning process. Thus the simplest, or crudest, imitation must be one that reacts in the same way to the same stimulus as the one that the model reacted to. Alternatively, the stimulus created by the model (a signal or goal-directed act of some kind) must be the same as the one the imitator experiences when he acts in imitation. This is the 'contagion' or 'pseudo-imitation' of Piaget (1962) or the 'emulation' of Tomasello (1990), where the goal or end-effect is reproduced but not the (intended) form of action (Byrne, 1995). Parallel acts can be generated by two or more subjects tracking the same event, chasing the same goal, or tracking one another.

Significant (or 'true' or 'immediate') imitation somehow goes beyond these short-cuts or parallel reactions. It involves a transfer of some amodal perceptual effect beneath or inside modalities, or a substitution of equivalent movements that differ in superficial anatomy but are similar in stimulatory potential; for example, the same in timing, with the same in dynamic (emotive) configuration or 'attunement' (Stern, Hofer, Haft and Dore 1985; Stern, 1993; Trevarthen, 1986). Human mimicry exhibits those cardinal features of conscious intentional behaviour; flexibility of both sensory confirmation (intermodal equivalence) and rhythmic motor execution (motor equivalence) (Trevarthen, 1978; 1993b).

In what way could the imitative form be translated between subjects? The empiricist assumes it must be constructed by trial and error, or by successive approximation, that it must be guided by reinforcements that the imitating subject experiences as positive for forms of action that are to

be strengthened, or negative for non-imitative components. This is a tautological theory, and, with all simple 'mechanistic' theories, it cannot explain neonatal imitation which is naive and immediate. The special generative features of motives and emotions and their communicability must be taken into account.

The only way to explain why an animal acts in a particular way, or changes the way it has been acting by developing new interests or tactics, is to take account of its motives, the internally generated impulses that propel activity. When the act depends on what the stimulating environment can afford, information from the environment is essential to the progress and successful culmination of acting. Almost all acts are investigative, or at least selectively reactive. But distinctly different forms of action are not simply different because the environment makes them that way. The subject's motives specify *in advance* what environmental affordances are to be the object of acting.

Imitation as communication

With Užgiris (1981, 1984), we see infant imitation as effective and functional in interpersonal communication from the start. Imitating is an integrative psycho-social generator of learning, even for a newborn, and it operates with many well-differentiated emotions. It is not just the tracking and study of novelty to solve general problems of acting and a way to construct new cognitive schemata. It is not a reaction that serves merely to regulate arousal. As the infant's mind develops, interpersonal or intersubjective imitation manifests itself as the developmental source of the peculiar narrative or discursive (propositional) and potentially 'socio-dramatic' form of human rationalising. We imagine thinking to be extended to impersonal, unimpassioned abstract or general categories of event by a metaphorical analogy, by a subject taking the objective event or form (in 'episodic' experience) to be an extension of the body and its movements, but doing so in a creative recollective manner, detached from actual communication.[3]

Kinds or grades of imitation are related to motives, attentions and intentions of differing complexity, involving more or less cognition or more or less experience and memory, and imitations also differ in their fundamental aims and generative progression. Their meaning changes. Their form and time differ in corresponding ways, and the *gist* or *style* becomes essential and fundamental information for partners in interaction about what companions are doing. Imitation is thus not simply a way one individual acquires a new behaviour, it is a regulatory interpersonal (intersubjective) process that brings motives of different individuals into productive engagement (Užgiris, 1981). In consequence, imitator and

imitatee are always ready to exchange roles – to reflect one another, and to show and negotiate initatives that way.[4]

The neonate's inborn plan for matching with the bodies and actions of persons: how they behave when they imitate

Newborn infants, though weak and inexperienced, are sentient and intending agents. They have a coherent prospective world for moving in which, for example, they perform 'prereaching' with arm and hand aimed to points outside the body and co-ordinated with head and eye rotations (Trevarthen, 1975, Trevarthen et al., 1981; Von Hofsten, 1983a). These movements can occur without a perceived object, perceptually speaking 'in vacuo' (or rather 'in corporo', by activating the body's field of activity), but the newborn can also 'lock on' to within a few degrees to an 'out-of-the-body' object that the infant is looking at, and the synchronised head–eye–hand co-ordination can be modified to track a moving exterior target. This 'imitation' of an outside event is clearly built upon the generation within the infant's mind of a coherent, 'in one time', body-related *behavioural field*, an 'action space' radiating from a single 'ego centre' (Trevarthen, 1980). Generative goals for an infant's acting can be perceptually confirmed and elaborated, but they do not originate as effects of stimuli popping up in a formless field of awareness, and they are not made up of disjointed and unsynchronised bits.

The newborn human also generates many 'expressions' appropriate for communication with another human – head rotations and tilts, patterned expressions of upper and lower face that involve displacement of receptive eyes, lips and tongue, vocalisations, and elaborate gestures of the hands.[5] The hands of a newborn are already organs with two distinct modes of purposeful operation; for intentions of the self directed to objects, and for expressions to others (Rönnqvist and Von Hofsten, 1994). In the latter case the movements of the hands 'belong' as much to the motives of the other as to the motives of the baby. Indeed, all the expressive behaviours have this 'double aspect' motivation – they are *both self-regulatory and other-regulatory*.

Each of the expressive forms of movement can be imitated if a human partner acts in a particular way that is timed and formed to interact with the rhythms of attending and intending that the infant is displaying. Each is isomorphic with movements the subject may make to sense the body and/or the environment in a special focused way. That is, each is also a component of intentional awareness, and that is why they are rich in information for a sympathetic other seeking co-operative awareness.

The dynamics of movement is a critical stimulating element for a

model to be imitated by newborns (Vintner, 1986), and neonates may attempt to imitate the rhythmic pattern of a repeated model (Kugiumutzakis, this volume). As we shall show, even a premature newborn is ready to engage in a reciprocal, rhythmic vocal interaction with a sympathetic, imitative partner. The movements of expression exhibit pronounced rhythmic cohesion, and rhythmically measured repetition of a model expression in a spontaneous communication game with a parent or in an imitation test with an experimenter seems to add to the salience of the model for the infant correspondent. However, neonates do not imitate well when models are presented with mechanical regularity and insensitive insistence, as can be the case in 'well-controlled' experiments that aim to reduce the factors that might be involved in triggering a matching response (see Kugiumutzakis, 1993; this volume).

All the evidence points to the conclusion that, as for pre-reaching, engagement with a person as object for an imitative communication depends on the presence in the infant of a latent motive or prediction to respond in that kind of way and in that general direction. That said, there is good evidence that infants can track an unexpectedly changing model when they imitate, and they can improve matching by a successive approximation after the motion of the model has ceased. Again this resembles the situation in reaching beyond the body where the goal is located in a common representation of the space for moving such that all modalities of proprioception (mechanoreceptive and exproprioceptive) are in concordance, and where final realisation of the act may be assisted by adjustments to the goal object at a second phase of execution. A tongue protrusion matching sight of another person's performance must match the infant's expected reafferent 'feel' of making a movement of that form, in that part of the body-movement space. As Kugiumutzakis (this volume) has explained, imitated movements of the upper face may involve less adjustment because the motor field is relatively simple there, with fewer muscles, in comparison with movements of the mouth and tongue for which there are many more motor possibilities and a much larger neural representation in the cerebral cortex. Neonatal behaviours in imitation tests confirm this idea. Newborns make relatively simple reproductions of eye closure, but more effortful and varied attempts, with successive approximation, for tongue protrusion.

Newborns indicate their special awareness of other persons by their reactions to being held and moved by a person, and by their visual orienting to, and fixation on, the face of a person near them. But they are especially sensitive to the human voice, and show a preference, possibly already established antenatally, for the voice of the mother (DeCasper and Fifer, 1980; Fifer and Moon, 1995). Eye-to-eye contact, which is firmly established

around the end of the first month, but which is adumbrated by a searching of the upper face for eye-contact that newborns make in spite of their immature foveae, is of special interest because this amounts to a mutual imitation of acting and experiencing, simply because mutually oriented eyes are both stimuli and receptors. One-month-olds also clearly see mouths and hands of their partners. Tests of imitating in infants within a few hours after birth prove that an inexperienced newborn can see, and differentially recognise, eyes, mouth, tongue and hands. This is the conclusive evidence that immediate (not learned and not symbolically mediated) imitation of conversational expressions is an innate faculty in humans.

The above observations and explanations confirm that every movement and every perception of a goal for moving is formulated around a core *motor image*, with its dynamic (kinematic and energetic) and physiognomic (body-form related) characteristics, and with predictive regulation of the reafferent effects that its expression will have in perception (Trevarthen, 1986).

Imitation cycles microanalysed in communication with infants

'Conversational analysis' of films or video recordings of non-verbal components in natural interactions between communicating adults have demonstrated the precision of synchrony between movements of expression, both within subjects (intrasynchrony) and between them (inter-synchrony). Application of the same micro-analytic techniques has shown that mother–infant interactions achieve similar levels of efficiency in coordination and similar precision of timing (Beebe, Jaffe, Feldstein, Mays and Alson, 1985; Condon and Sander, 1974; Jaffe, Stern and Peery, 1973; Mayer and Tronick, 1985; Stern, 1974; Stern, Beebe, Jaffe and Bennett, 1977; Trevarthen, 1974, 1977, 1979). Imitations occur between adults as part of the regulation of transactions of feelings and intentions between them. The same function is served by natural reciprocal imitations between infants and their partners.

To appreciate the remarkable *timing* features of imitative behaviour in infancy, which we feel have been seriously neglected, it is necessary to recall that all sentient and voluntary behaviour has a tendency to cyclic patterns in which rate of movement and repetition of movements are strictly controlled in a prospective intracerebrally determined plan of bodily action. Skills are attained by repetition of moves measured in a neurogenic action-time. Central coherence of the timing of movements and the processing of sensory data is essential to biomechanical efficiency and unity of consciousness (Bernstein, 1967; Pöppel, 1994), and this

internal source becomes the origin of intersubjective sympathy and co-operative intentions.[6]

Baldwin (1894) called cyclic or iterated behaviours, where an act is repeated to explore sensory effects and improve performance, 'self-imitations'. Piaget (1953) adopted Baldwin's concept in his formulation of a theory of how body awareness and object concepts are achieved in infancy by mutual assimilation of schemata for *circular reactions* of differing complexity and degree of conceptual determination ('primary', involving only the body, 'secondary' involving a manipulated object, 'tertiary' involving a symbolic representation). By concentrating on individual self-regulation first, both Baldwin and Piaget and other investigators of infant intelligence and imitation (e.g. Guillaume, 1971; Wallon, 1970), with most modern developmental psychologists working in the behaviourist and cognitive traditions, have failed to take account of the precocious efficiency of cyclic 'self–other' regulations between subjects. This is why imitations of newborns have been ruled out as 'theoretically impossible'. The problem has been created by the theory that infants are born without integrated psychological powers, and are incapable of organising themselves as (rhythmically) coherent intentional psychological subjects, and by the corollary that they are incapable of having any consistent relation with any object and its properties.

To dispel these false beliefs, we first describe the behaviours of an infant in dynamic emotional interaction of protoconversation with an adult. From this analysis we can form a description of the rhythmic cycles and phases of motivation that generate and regulate such phenomena, which are essentially psychological because they are organised by and sensitive to states of mind that are given a primary regularity by motive states in the brain in three fundamental dimensions of embryogenic origin: *morphology* (structure), *intensity* (energy) and *timing* (process) (Trevarthen, 1986). The communicative interactions of young infants show that regulators of all three of these dimensions are installed in the brain and body before birth.

Imitation can then be seen to be one of many dynamic intersubjective patterns of behaviour that arise at definite places in the dynamic configurations that two mutually interested subjects tend to create. That the two subjects have a natural readiness or predisposition to 'dialogic closure in felt immediacy' (Bråten, 1988; 1997) is proved by the efficiency, productivity and regularity of events in protoconversations between infants and their intuitively responsive mothers or fathers. That this process is dynamically negotiated or 'worked out' on the interpersonal stage is shown by the systematic perturbations or risks that the interactants tend to introduce as soon as dialogic 'confluence' has been achieved, especially when it is between familiar partners in familiar territory and with familiar routines of play (Nakano & Kanaya, 1993; Reddy, 1991). These perturbations expose and engage the dynamic regulations of motives in the two individuals. Nakano (1996) calls them 'incidents' and describes the motives for them in humans, particularly infants and parents, as manifestations of 'incident affinity' within 'the space of the We'.

Protoconversational interaction with imitation

A microanalysis of a conversational development over 30 seconds between a mother and her 6-week-old daughter will serve to illustrate essential features of primary intersubjective dialogues or protoconversations that emerge in the second month after a full-term birth (Figure 5.2).

This example exhibits a remarkable precision of timing in the alternation of utterances between the infant and the adult, which indicates that they share a rhythmic 'time-base' for expression, and perhaps that they have matching *cycles of motivation* leading to regular sequences of active expression (*assertion*) and attentive reception (*apprehension*), or of 'intention' and 'attention' (these terms for phases of expression and awareness are discussed below and diagrammed in Figure 5.8). Estimated bar lengths are remarkably regular (mean = 1.55 sec; sd. = 0.04 sec), and the infant enters into precise co-ordination with the mother's rhythm. This spectograph, and those shown in Figures 5.3 and 5.4, have been prepared in the course of a detailed acoustic analysis of mothers' speech to infants (Malloch, Sharp, Campbell, D., Campbell, A. and Trevarthen, 1997).

It will be seen, also, that imitations can be identified in both directions, but most frequently of the infant by the mother when she makes vocalisations of sympathetic encouragement, and that they occur at particular points in the interaction. They appear to play a role in the development of co-ordinated mutuality. The mother's imitations are protracted, amplified or enhanced versions of the infant's sounds (Papousek and Papousek, 1989). They seem to be intended as supportive emotionally coloured 'attunements' (Stern et al., 1985) of dynamic emotional forms (Stern, 1993). In this sample, imitation clearly serves a between-subjects communicative function, in association with many other sympathetic reactions of a non-imitative kind, such as smiles, hand gestures and various vocal expressions of feeling.

Throughout this interaction, mother and infant maintained mutual gaze, broken only briefly when the infant was excited to make a vigorous utterance, or when the mother's attention was distracted. Mutual gaze, being a potent sign of intersubjective reciprocity, is, as mentioned above, a kind of imitation. It is used to regulate the degree to which the partner

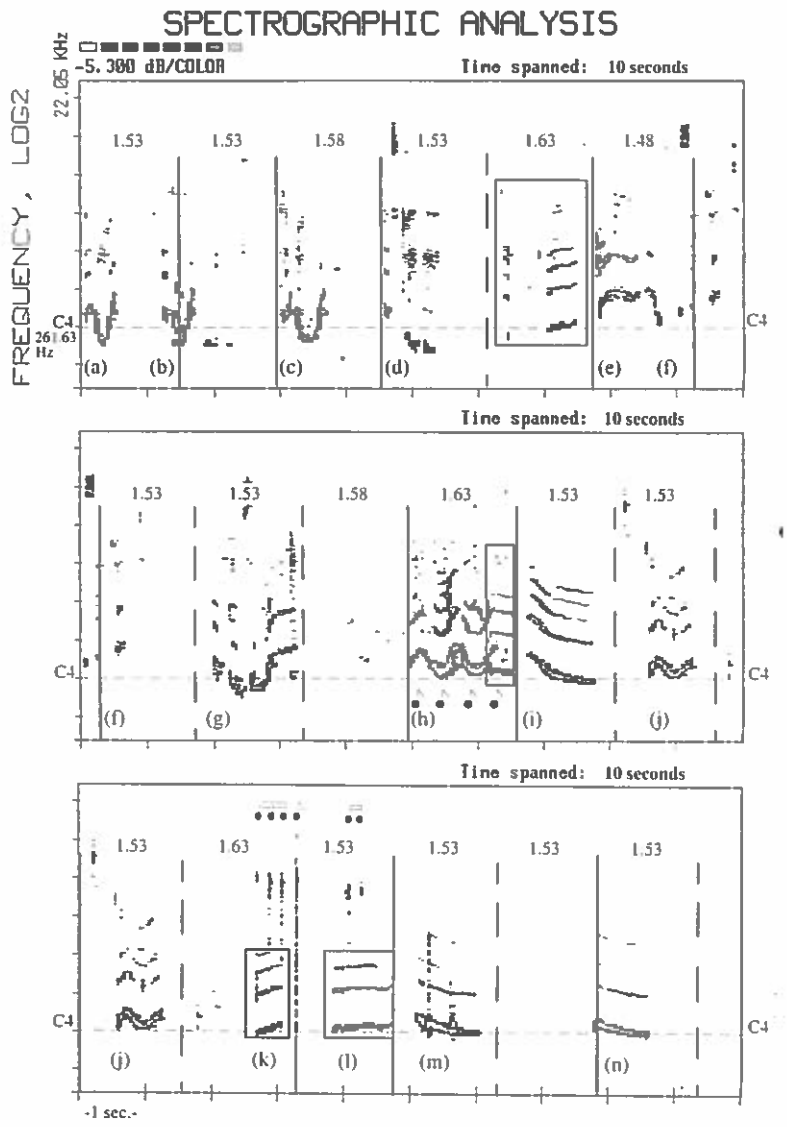

Figure 5.2. Mother speaking to her 6-week-old daughter who is seated opposite her in a baby chair and paying close attention, and occasionally smiling, vocalising and gesturing. This example of an extended (30 seconds) protoconversation, ending in a rhythmic nonsense game with the mother bouncing the baby, illustrates the rhythmic pattern of 'intuitive motherese'. A musical bar structure is set up in which the short, repetitive utterances of the mother, and the

'intrudes' (Robson, 1967; Stern, 1974). Removal of gaze from a partner can indicate avoidance, or it can show a change of interest towards another object. The latter becomes an increasingly important signal with older infants as they begin active exploration of surroundings and start to seek goals for observation and manipulation.

In interactions between young infants and their companions, one observes many behaviours that are triggered by actions of those other persons. Some of the infant's expressions are obviously adapted to soliciting human aid to help the infant feed, sleep or maintain comfort. They engage caregiving motives of the adults, and are responded to with actions that minister to the infant's apparent need, or that give emotional solace or support, as when a mother makes comforting sounds and lifting, rocking or patting movements to calm a fretting baby. Others, however, like Laura's utterances in the dialogue with her mother, are addressed as contributions to explore a communicative interaction, and they are responded to in that guise. They are seeking reciprocal, dynamic engagement of motives for their own sake in expressive forms of facial movements, vocalisations, posture changes, limb movements and hand gestures, including touching movements. Imitations that take the form of emotional expressions are easily seen as part of the regulation of interpersonal contact itself. More methodical or 'studious' imitations may have a self-stimulatory, self-regulatory purpose. They reproduce the other's act to test its regulation in the self. They may or may not convey a message about the balance of intersubjective purpose.

The state of the imitative mechanism before term

Innate principles of imitative reprocity in neonate imitation are indicated in a remarkable recording that Saskia van Rees has made of a precocious proto-conversation with imitation between a father and an 8-week premature infant that was born 5 weeks previously at 27 weeks gestational age (Van Rees and De Leeuw, 1987; Trevarthen, 1993a, Figure 3.2). In this

Caption to Figure 5.2 (*cont.*)
infant's responses, are inserted. The infant's vocalisations (*), which overlap or replace the mother's in the pauses she leaves, are enclosed in rectangles.

Mother's speech:
(a) Come on; (b) Again; (c) Come on then; (d) That's clever!; ****
(e) Oh, yes!; (f) Is that right?; (g) Well, tell me some more then; (h) Tell me some more then *; (i) Orrh!; (j) Come on; (k) ch-ch-ch-ch **;
(l) ch-ch ***; (m) E-gooo!; (n) Goo!

example, the father, who has the infant under his clothes resting against his chest, is gently touching the infant's hands and face, imitating expressions and gestures, 'showing' them to the infant, and exchanging vocalisations. His sounds clearly imitate the infant's coos in duration and pitch, but they are a little stronger and more sustained, with deeper formant components. Infant and father do not actually have eye contact or mutual gaze because the infant lies with eyes closed, but the father holds the baby to him with the right ear against his chest, and he studies the baby's face and hands closely. They share timing of movements, and especially of vocalisations, with remarkable precision (Figure 5.3). The infant's quick responses to the father's sounds appear themselves as imitations, because they are clearly responses in the same form. This shows how in reciprocal interaction the roles of imitator and imitatee may blend so that who is imitating whom becomes indeterminate. It is interesting, too, that the infant makes a slight rise in pitch when the father fails to respond.

Father and infant alternate vocalisations at approximately equal intervals on a clear pulse. In Figure 5.3, a and b, it can be seen that the father imitates Naseera 14 times with an interval about 0.75 seconds, and Naseera imitates him with about the same timing, or even more quickly, on 10 occasions. In the enlarged portion, Figure 5.3, c, the father follows Naseera 7 times at an average interval of close to 0.75 seconds (0.65 to 0.85 sec) and Naseera reacts to him twice with the same interval (0.7 sec). When they are interacting, the intervals of either the father's or Naseera's vocalisations are usually either 2 or 3 times 0.75 seconds (*c.* 1.5 sec, or 2.1–2.5 sec). When they are vocalising on their own, however, both seem to generate a longer phrasing interval. At the beginning of Figure 5.3, 'a' the utterances of Naseera are 6.6 seconds apart, and the father's imitated replies are 6.8 seconds apart. In the middle of 'a' the father waits 4.5 seconds before calling Naseera again. At the end of 'a' and the beginning of 'b' Naseera makes a series of vocalisations separated by 4.1, 3.7 and 4.7 seconds, with no supportive vocalisations from the father.

The cycles of attending and intending of the infant and father appear to form a two level hierarchy, the different durations being approximately 0.75 seconds and 4 seconds, levels which match remarkably well the 'utterance' (0.64 ± 0.18 sec) and 'phrase' (3.7 ± .066 sec) components recently reported to be characteristic of spontaneous vocalisations of infants from early months (Lynch, Oller, Steffens and Buder, 1995). The mean 'utterance' (0.83 ± 0.62 sec) and 'phrase' (4.10 ± 2.50 sec) elements were also found to be preserved without much lengthening in the case of an infant born totally deaf because of atrophy of the cochleas (Lynch, 1996). Matching elements and phrases of perception and action are found in adult speech, in poetry and in music, indeed in the cognitive

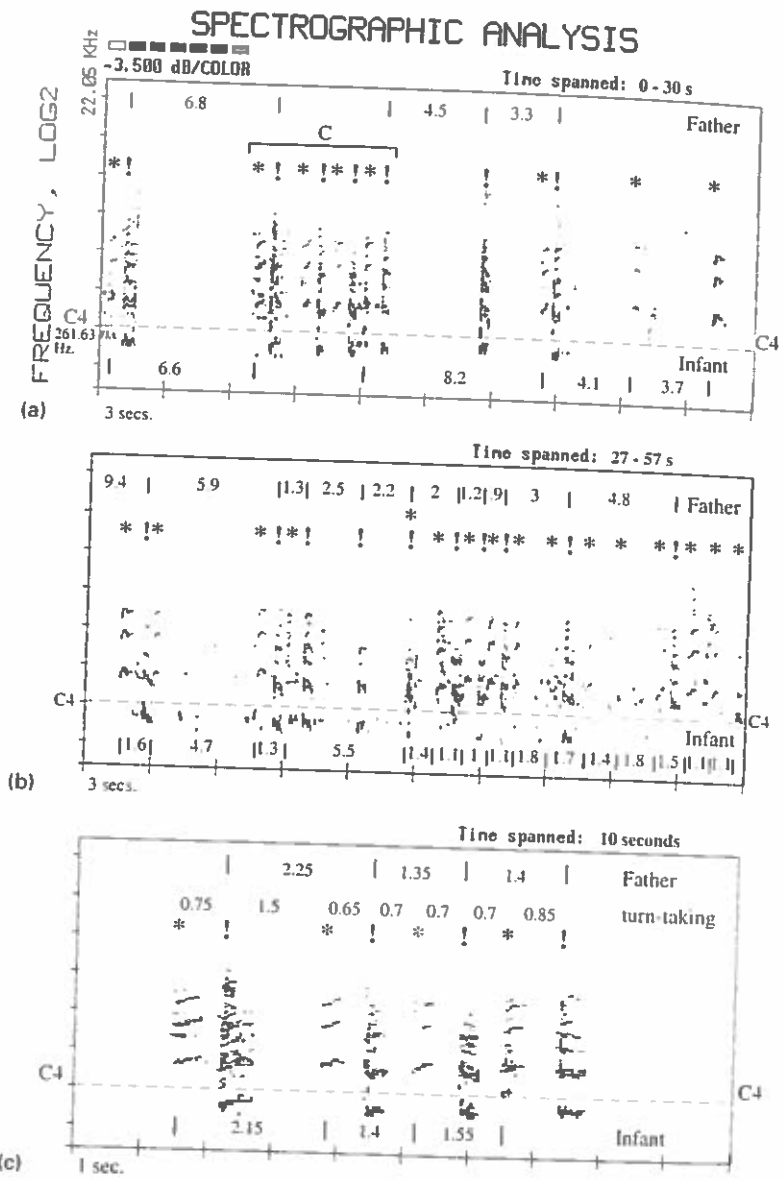

Figure 5.3. Sound track from the original uncut rushes of a video made by Saskia van Rees (Van Rees an de Leeuw, 1987) of a father with his 8 week premature daughter who is 'kangarooing' inside his clothes against his chest. The two vocalise rhythmically together, the father imitating the short, high pitched coos of his daughter.

and motoric processes of human perceivers or actors of all ages (Fraisse, 1984; Pöppel, 1994;Turner and Pöppel, 1983).

The imitations of this premature infant with the father are part of a longer temporally organised performance in which the two participants exchange parts and wait to correspond, with matching sense of timing. Both are apparently acting voluntarily or predictively. They appear to be mutually aware and seeking to recover the interaction when, for some reason, one or other fails to sustain an exchange. They each wait for several seconds for the remembered responses.

Developments in infant's motives to communicate, and changing imitations

Imitation evidently has dynamic, intersubjective regulatory functions from the beginning of human interactive life, but the messages it conveys change as the infants motives undergo age-related developments. These changes relate to developments in memory, in 'self-awareness' and in discrimination of cognitive categories, but they cannot be explained by a cognitive/associative theory. More fundamental internally generated changes in motivation for co-operative action and intersubjective play must be invoked.

The above examples are characteristic of Primary or Innate Intersubjectivity, where the motivation is focused on immediate regulation of communication itself. Beyond 3 months, an infant has increasing interest to explore surroundings, with the rapidly maturing abilities to make selective visual inspection and with more precisely directed and more deliberately selective movements of manual prehension. At the same time the body is stronger and many movements are of a kind that engage the different body parts in rhythmic and endlessly varied patterns of activity. Evidently bodily self-stimulation and acquisition of more efficient perceptuo-motor control is one purpose of these behaviours that contributes to their development.

The development in range and vigour of attending and acting at this age correlates with a more playful reaction to a partner's attempts to obtain communication. Games develop where the timing of moves is more complex than in the early weeks, and where the risks of incompatible expressions and 'teasing' provocations multiply. The emotional expressions of infants become more subtle, too, including coy or shy evasions of the attempts of familiar persons to engage them in play (Reddy, 1991). Expressions as of distressed 'shame' appear in interactions with strangers, or with familiar individuals who are not responding in their normal way, or who are behaving in an inaccessible way (Murray and Trevarthen, 1985; Trevarthen, 1990; Weinberg and Tronick, 1996).

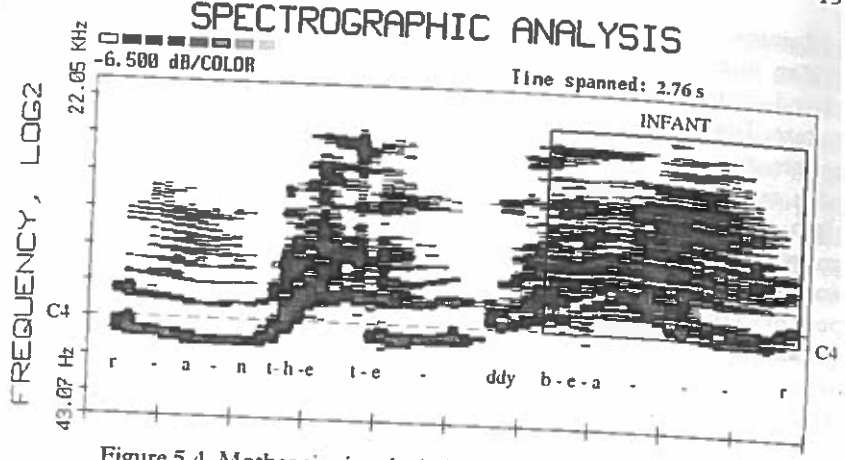

Figure 5.4. Mother singing the baby song, 'Round and round the garden, like a teddy bear' to her 24-week-old daughter, who joins in to vocalise, with matching pitch, on the final syllable of the word 'bear', an extended vowel. See the rhythmic structure of the song in Figure 5.9.

One highly characteristic feature of this period is the development of *rituals of play*, in which patterns of expressive behaviour and turn taking are formulated and repeated many times, and greeted with signs of pleased recognition on the part of the infant (Bruner and Sherwood, 1975; Hubley and Trevarthen, 1979; Papoušek, Papoušek and Harris, 1987; Ratner and Bruner, 1978; Stern, 1974, 1985; Stern and Gibbon, 1980; Trevarthen and Hubley, 1978; Trevarthen et al., 1981; Trevarthen, 1990). Parents play *teasing games* and begin to perform *baby songs* that enable the mother to excite attention to repeating patterns of rhythm and melody (Papoušek, Papoušek and Symmes, 1991; Trehub, Trainor and Unyk, 1993) and *action games* in which the infant's body is moved rhythmically to melodic patterns. The rhythms and prosody of these performances lead the infant to make contributions that are timed to alternate with the mother, or to coincide with climaxes in excitement (Stern, Jaffe, Beebe and Bennett, 1975).

Baby songs have regularities of timing and intonation which seem to imitate the infant's capacities to predict a sequence of cyclical expressive events, the 'emotional narrative' or 'dynamic emotional envelope' (Stern, 1993). They are imitated at certain points by the attending infant. We offer a typical example in which the baby imitates the mother's singing of a well-known song by sharing in an emphasised climax feature, the final vowel of a phrase, one that rhymes with the ending of a line that comes later in the verse of the song (Figure 5.4).

Maratos (1982), Kugiumutzakis (1985, 1993, this volume), Heimann, Nelson and Schaller (1989) and Heimann (1991) have charted age-related changes within the first 6 months in what infants are willing to imitate. Towards the end of the first year, infants first become attracted to imitate *ritual performances* that are made into often repeated games or jokes, such as waiving goodbye and clapping hands. These imitations are often deferred; that is they are often reproduced by the infant, unprompted, after an interval of days. They may also be employed 'instrumentally' by the child as an 'opener' for interaction with a different person (Trevarthen et al., 1981; Trevarthen, 1990). Such features led me to call these imitations 'discretionary', because they have a new flexibility of intention or deliberativeness in comparison with early imitations, which are more ingenuous or 'magnetic' (Trevarthen, 1982).

After 9 months, infants start to attend more deliberately to the gestures that a partner makes as indicators of their intentions in performance of a task, or to the expressions of emotion that indicate how they, the partner, evaluates a new or uncertain object or situation (emotional referencing) (Heimann and Ullstadius, this volume). A one-year-old is more willing to co-operate in a joint task, or to 'comply with' it, by 'completing an instruction' than he or she is willing to imitate a demonstration (Hubley and Trevarthen, 1979). In other words, into the second year the baby accepts information from gesture and vocalisation about an incomplete intended action, and he or she is eager to complete it. This is the behaviour that identifies purposeful joint attention in Secondary Intersubjectivity (Trevarthen and Hubley, 1978), the generative step in development of protolinguistic collaboration (Bretherton and Bates, 1979; Bruner, 1983; Halliday, 1975). Meltzoff has made an experimental demonstration of this completion of intentions in infants by 18 months (Meltzoff, 1995). The way imitation changes with age because the child's motives change is beautifully demonstrated by Nadel in her studies of 'immediate imitation' by toddlers, following principles enunciated by Wallon (Nadel, 1986; Nadel-Brulfert and Baudonnière, 1982; Wallon, 1970).

Imitation in different relationships, I: fathers and mothers with infant boys and girls

Imitation is always an interaction between acting subjects, even in the simplest case of contagious parallel movement, and therefore it depends on the motives of the partners. For this reason we should expect imitation to be different with different partners, both on the side of the infant and on the side of the partner.

If it is correct that infants are born imitators, in possession of a human

motive system that can respond to intentional and emotional expressions of human partners, and that is motivated to learn from repeated experiences of mimetic interactions with familiar individuals, they should be willing and interesting partners for communication not only with their mothers, but also with their fathers who are also likely to address them with sympathetic affection. But traditional psychological theories gave fathers a minor role in the development of infants' communication. This appears to reflect a preoccupation with the physical or organic needs of the young infant, and the idea that the father is the representative of rationally ordered society.

In a sophisticated society where fathers felt distanced from their young children, Freud conceived of motives of infants in interaction with their mothers as primarily for gaining physiological benefits of comfort and nourishment. He thought that more elaborate emotions developed later, around sexual desire. The father had no place in the first stage, but, for a boy around the age of 4 or 5 years, a father becomes significant as a sexual rival for the mother's affections. Freud described the emotions of father–son relationships as competitive, agonistic ones, mixed, as the boy becomes more self-aware, with positive feelings that identify the father as an exemplar of socially (sexually) effective behaviours.

Freud defined *identification* as 'the assimilation of one ego to another one, as a result of which the first ego behaves like the second in certain respects, imitates it and in a sense takes it into itself' (Freud, 1933, p. 94), or, 'the endeavour to mould a person's own ego after the fashion of one that has been taken as a model' (Freud, 1921, p. 63). Like Baldwin and Piaget, he believed that the integrated feelings of the infant's ego were acquired first from the body by self-stimulation. In the sexual sphere this means 'libidinal aims' are satisfied by 'auto-eroticism'. A representation of an 'object' emerges as part of the self in 'narcissistic identification' when self and non-self are confused or merged. First the mother, and subsequently the father become separately conceived objects of identification.

It is clear that there is no place in Freud's theory of early infancy for imitative self–other reciprocity (primary intersubjectivity). When the infant's mind is beginning to separate a world of objects from the self, the dependence of both boys and girls on the mother is absolute. Her comforting presence is sought in actions and in fantasy. Later, the boy experiences a desire for his mother, at the same time identifying with the father defensively or aggressively, wanting to be like him, but fearing him as a competitor for the mother's care and affection. For a girl there is no such conflict, her identification with the mother being secure.

Psychoanalytic work by Anna Freud and Dorothy Burlingham explored the idea that the father can become a significant role model and source of

self-regulating impulses earlier than Freud had thought, in the pre-Oedipal stage. 'The infant's emotional relationship to its father . . . is an integral part of its emotional life and a necessary ingredient in the complex forces which work towards the formation of its character and personality' (Burlingham and Freud, 1944). According to Anna Freud (1965), imitation of parents begins in early infancy and increases as awareness of the object world expands and motor skills improve. She considered that the infant develops an identification with a parent from pleasurable experiences of being imitated by them in the pre-Oedipal phase, and that this identification, being motivated by a wish to change the self, is a forerunner of the super-ego (Machtlinger, 1976, p. 300). The conscience (conceived as a learned representation of an 'internal legislator) is a later development from merely desirable ideas of the self which are transformed by the introjection that follows from identification. In reaction to paternal aggression, the little boy changes from a threatened passive person to a threatening active one, imitating the father (Kugiumutzakis, 1983).

Burlingham observed that the emotional handling a father had experienced as a child from his father can have a strong influence on the way he feels and acts with his own child. Fathers may say they are imitating their own fathers, even continuing to act as their fathers did against their better judgment (reported by Machtlinger, 1976, p. 293). Such 'echoes of intimacy' carried over from childhood have been confirmed in the work on transgenerational effects in attachment of Main and Goldwyn (1984) and Fonagy, Steele, Steele, Moran and Higgitt (1991). This research has shown that an infant's attachment to each parent depends on the way that parent relates emotionally to the infant. Burlingham also noted that girls and boys are treated differently by both fathers and mothers; 'I cannot help feeling that, in spite of and beyond the complexities of parental characters, and also in spite of the alleged modern equality of the sexes, many of the either female or male characteristics of the parents will continue to exist and, in response to them, the infants' differentiated emotional reactions and differentiated experiences of pleasure' (Burlingham, 1973).

Like psychoanalytic theory, social learning theories and more recent cognitive developmental theories have assumed that the father contributes little to child development before 4 years, when he offers a sex role identity for boys. He has little to offer for the early socialisation of girls. For both Thorndike (1898) and Watson (1908), imitation is not instinctive; it starts from perception of the chance similarity between a vocalisation and a sound the infant hears, and Watson added that adults imitate young infants more than the infants imitate them. Parton (1976) exemplifies the standard associative view that imitation is constructed from responses already in the child's repertoire by classical conditioning –

the adult copies the infant's behaviour and the infant tends to repeat the reiterated response, and this encourages an increase in the infant's tendency to imitate (Kugiumutzakis, 1983). Gewirtz and Stengle (1968) claimed that boys imitate their fathers because they are rewarded for doing so, and Baer and Sherman (1964) add that imitation gains reinforcement value because it is rewarded, and thus becomes its own reward. Such theorising dismisses any innate tendency to imitate, and denies a specific adaptive value to imitation.

A tendency of infants to accept rewards more readily from models that resemble themselves was demonstrated by Sears (1953), Kagan (1958) and Mussen and Rutherford (1963), but for Mowrer (1950) and most other learning theorists identification with a parent depends on the nurturance and reward that the parent supplies, thus boys are likely to imitate fathers who are loving and warm, even if the imitations are not rewarded directly.

In the cognitive developmental view, moral identifications are not made by imitation until a relatively advanced stage of development, and accordingly a theory of identification with parents must be part of a much broader account of mental development (Kohlberg, 1969). According to this theory, imitation is motivated not only by interest in the dimensions of the activity itself (its complexity, novelty, etc.), but also by the effects of the act upon other objects. Major developments in what will be accepted as a model for imitation are due not to the formation of new motives for imitation, but to cognitive–structural changes in concepts of role competence. These result in a rechannelling of primary competence motivation into varying channels of selective imitation (Kohlberg, 1969). The cognitive–developmental theory claims that the child learns to sex-type himself and his activities during the second and third year. By the age of 3 to 4 the boy knows quite well he is a boy and prefers 'boy things' to 'girl things' simply because he likes himself and those who are familiar and similar to himself. Before this point in his development, he was mother-oriented. Tending now to prefer masculine activities, he seeks a model for these activities. Thus he is led to select his father rather than his mother as a model. Imitation, in turn, leads to emotional dependency upon the father (Kohlberg, 1969). Emulating fathers' skills, thinking and vocabulary aids the cognitive development of boys (Radin, 1976).

Thus, learning theories and cognitive developmental theories, while emphasising different processes, both claim that the father starts to be an imitated model for a boy only when the boy is around 3 to 4 years of age.

Ethologists seek to explain the inherited phylogenetic roots of paternal behaviour (Lynn, 1974). The permanent social groups of primates comprise both sexes and have characteristics like those of human families.

It is beneficial for the male to stay with the family to assist and protect the female through a long and demanding pregnancy. It has been proposed that the male's sexual attachment to the female may have led to the development of fathering behaviour. This would suggest that human fathers stay with the family and derive satisfaction from their offspring for biological rather than cultural reasons. As a permanent member of the family, the male primate confers a combination of benefits, assisting in parental care and in defence of the group while gaining maximum access to receptive females (Eisenberg, 1966; Rypma, 1976). It has been suggested that male humans inherit a 'fathering instinct' that is satisfied and reinforced by features of the child, who is a source of pleasure. Motivated by curiosity, a new father is attracted to the child and through his senses comes to recognise the child as his. He finds that when he fondles and nurtures the child, it becomes attracted to him, mimicking and responding to him. 'To early man, as to today's man, imitation is the sincerest form of flattery, and it was flattering to see an image of himself mirrored in the behaviour of his child' (Biller and Meredith, 1975, p. 14).

In the plethora of studies on father–infant interaction in the last 25 years, not one is concerned exclusively with the development of imitative patterns in father–infant interaction in early infancy. The field continues to be dominated by preoccupations with development of social roles and acquisition of socially approved, or disapproved, behaviours. Differences in the behaviours of fathers and mothers, or of fathers' behaviour with sons and daughters have usually been related to contrasting cultural beliefs about the importance of a father in the development of young children. Nevertheless some detailed observations have been made which strongly suggest that very young infants can communicate with fathers, and that fathers may derive great pleasure from this.

In a study of medication in labour and the sex of the infant as factors affecting the interaction of the newborn with mother and father, Parke, O'Leary and West (1972) found that infants that had been exposed to tranquillising medication, being more lethargic, caused mothers to increase their efforts at interaction. Fathers, however, preferring an active awake infant, interacted less with neonates born with medication. It was also established that the father can be a very active participant in the family triad. Mothers smiled more than fathers, who may have been inhibited by the observation of their behaviour, but fathers tended to imitate more. Brazelton, Yogman, Als and Tronick (1979) observed that fathers can regulate, reciprocate and interchange behaviours with their infants, but fathers' behaviours showed qualitative differences in comparison with mothers' interactions with their infants. In the case of a 3-month-old boy with his father, these authors reported the following: the

father enters with a neutral facial expression and begins a narrative voc isation while the infant stills, sits upright and watches the father inter and quietly. The infant appears 'set' to interact. After about 6 secon the infant then greets his father with a wide grin and punctuates this w large, abrupt movements of his foot. Infant vocalisations are likely to be the form of laughs, short and intense, followed by long pauses, while t father imitates and amplifies his infant's facial expressions. Episodes mutual play are followed by pauses in which the father becomes less a mated (Brazelton et al., 1979, p. 32).

Greenbaum and Landau (1979) studied young infants' exposure speech by mothers, fathers and siblings in different environments at 2, 4 and 11 months. Vocal imitations appear to have been low compared other kinds of verbal response. Imitations of consonants uttered by t child, however, increased at 7 and 11 months in contrast to the precedi ages. Papoušek, Papoušek and Harris (1987) found no significa differences in maternal and paternal vocal matching with young infan Episodes of playfulness were described in the following categories: (infant vocalisation accompanied by a facial expression of pleasure, (vocalisations repeated after some aspect of the partner's behaviour ar thus potentially contingent upon it, (3) reciprocal matching of voc sounds or some of the parameters of vocalisations, (4) repetitive strings reciprocal sounds imitative of the infant's sounds, and (5) prosodic fe tures in parental baby-talk in games with the infant. After analysing labo ratory recordings of spontaneous 6-minute interactions of infants wit their parents at 2, 3 and 4 months in this way, they identified 128 episod of vocal play, 82% of which were initiated by the infants. There were n significant differences between mothers and fathers, and no changes wit the infants' age. Parents answered the infants' sounds by matching turns i 61.9% of cases, and there were no sex differences. Infants answered onl 17.4% of parental sounds with matching turns. Infants imitated onl mothers' sounds; no paternal sounds in vocal play were followed b infants' matching turns, even though, by definition, parental vocalisation in play were in the infants' repertoire. This difference between fathers an mothers was interpreted as evidence that some factor in the fathers, possi bly their relative unfamiliarity, discouraged the infants from imitating The families, it should be noted, represented the traditional Germar pattern, in which fathers spend most of the day in professional work whil mothers care for their infants. Field (1978) has compared infants' interac tions with fathers who are primary and secondary caretakers, and she con cluded that familiarity is, indeed, a significant factor. It seems generally believed now that fathers and mothers interact in similar ways with their infants, provided thay have equal contact (White and Wollett, 1987).

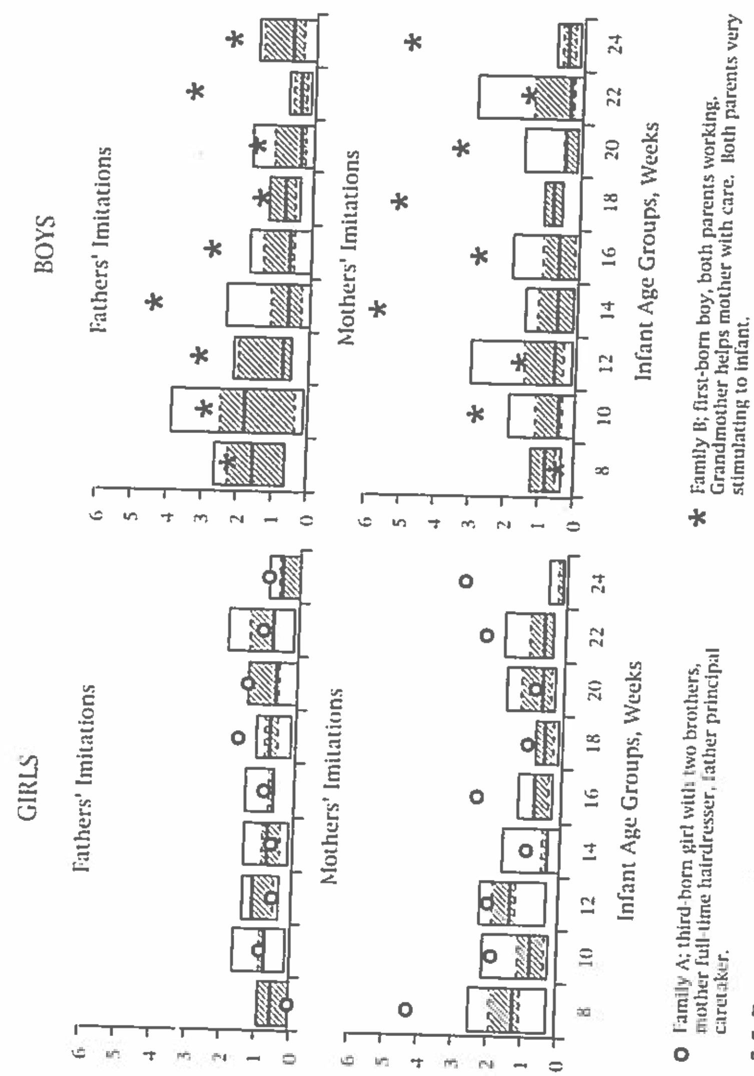

Figure 5.5. Parents imitations of infants in Crete. Rates of imitation of female and male infants by fathers and mothers at 2-week intervals from the 8th to the 24th week after the infant's birth. Two exceptional families (A O and B *) in which at least one parent imitated at a consistently high level, generally well outside the range of the other parents, are indicated separately. The bars indicate the whole range of imitations for the remaining adults (white), the interquartile range (cross-hatched), and the median rate (thicker horizontal line).

While there has been a significant change in the way fathers' relationships with infants are viewed, the above findings cannot be satisfactorily integrated or interpreted because there is no comprehensive theory of the role of the father in early infancy (McGreal, 1981). None of the classical theories (psychoanalytic, genetic epistemological, social learning or ethological) reveals either the true role of the father or the ways the infant affects the father. They all focus on the father's contribution to child development, especially psycho-sexual development, giving a one-sided and incomplete picture. None of the theories gives a place to differentiated emotional regulations that might be shared between a father and his infant, and their changes in the short or long term. They are not studying communication and its emotional regulations.

Varieties of early companionship of infants with fathers and mothers in Cretan families

We have preliminary results from a project recording spontaneous play in the home between mothers and fathers and their boy or girl infants between the second and sixth month. These results come from Kokkinaki's analyses of video recordings made in Rethymnon, Crete.[7] Nine video recordings were made at 15-day intervals, in each family, and at each visit both parents were recorded playing for 8–10 minutes with their son or daughter while the other parent was out of the room; father and mother in alternating order on successive visits. There were 6 girls and 7 boys in all. Parents were asked simply to play as usual with the baby in a comfortable position on the parent's lap, lying on a sofa or in a baby seat. The researcher behind the camera tried to be inobtrusive and out of the line of sight of the infant, and did not speak. Visits were made when the parents felt it would be most convenient and when the baby was fed, rested and expected to be in a good mood. Recording was interrupted if the infant was tired or distressed.

A digital time signal was added to the video recordings, which were then processed by microanalysis to encode imitations of all communicative vocalisations and non-speech sounds, all facial, hand and head movements, as well as all possible combinations of these behaviours. Parental imitations were defined as simple reproductions of any single vocal, kinetic or facial expression of the baby which were at least in part the same as the infant's preceding behaviour. This allowed identification of 'partial' and 'expanded' imitations as well as 'accurate' matches. Synchronous or immediate replies in a different form (e.g., a head movement in reaction to a vocalization) were not accepted as imitations.

Figures 5.5 to 5.7 show the rates of parental imitation (imitations per

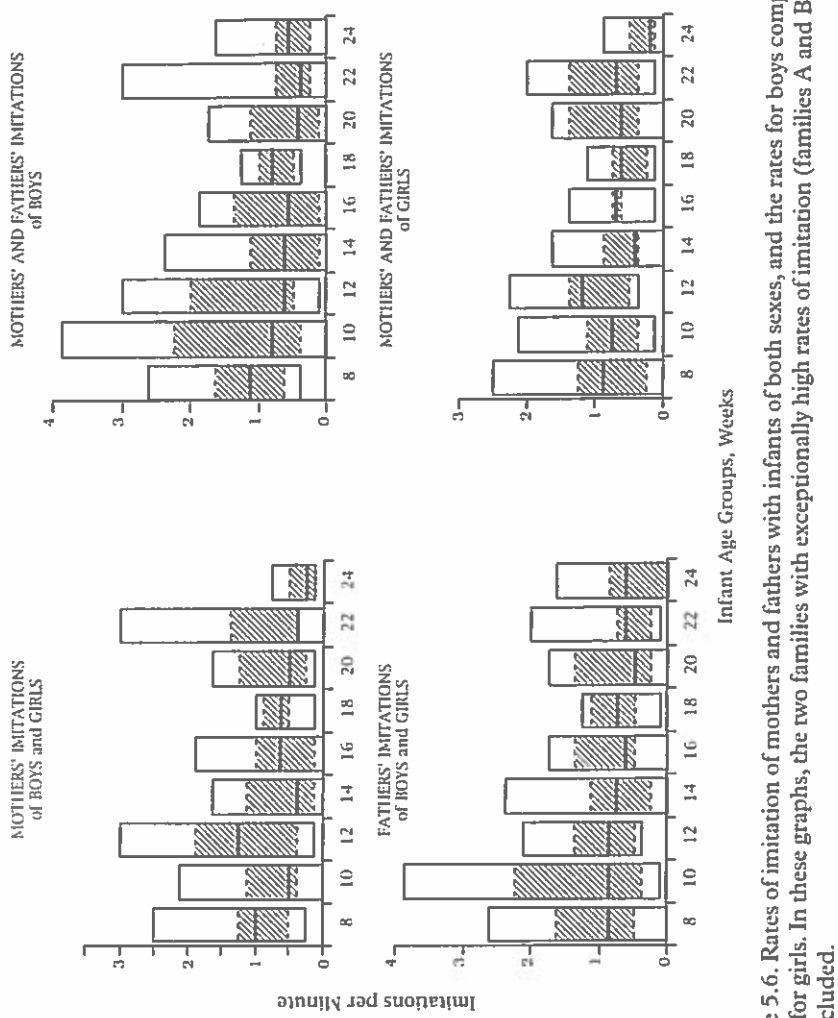

Figure 5.6. Rates of imitation of mothers and fathers with infants of both sexes, and the rates for boys compared with those for girls. In these graphs, the two families with exceptionally high rates of imitation (families A and B in Figure 5.5) are excluded.

minute) for an 8-minute portion of each recording. While these data must be regarded as preliminary until further details of the timing of responses, and the information from a similar population in Scotland, are available, we see interesting differences between the behaviours of fathers and mothers, differences in communications with boy and girl infants, and some parents who behave very differently from the majority. It appears, from Figure 5.5, that fathers of boys start by imitating more than fathers of girls, and that parents imitate less as the babies approach 6 months of age. In one family, exceptionally high rates of imitation may be related to the fact that neither father nor mother were principal caregivers. We will be interested to see if, in a larger population, there is a significant tendency for imitation to be more intense when the communication appears to require more effort on the parent's part.

When, as in Figure 5.6, left, the results from families with boys and girls are combined, there is little difference between parents. When the results for both parents are combined for boys and girls separately (Figure 5.6, right), it is clear that the boys are not only imitated by some parents more than girls, but the period at which the variance in imitation is reduced comes about 2 weeks later in boys (18 weeks) than it does for girls (16 weeks). This is an interesting confirmation that, at this stage of infancy, girls' development is a few weeks ahead of that of boys'. The same result has been obtained for binocular stereopsis (Held, Shimono and Gwiazda, 1984), for reaching (Von Hofsten, 1983b) and for communicative gestures (Trevarthen, 1996). If the effect is confirmed with more subjects, this will strongly support the hypothesis that developmental changes in infants affect the rate at which parents imitate their babies in play.

In Figure 5.7 there is a slight fall in the rate of imitation for the whole population, and a more conspicuous change in the variability of parents imitative behaviours with a minimum at 18 weeks. Put alongside indications of the occurrence of one of the temperamental, 'difficult' or regressive periods of infant behaviour, which have been reported by Dutch mothers (Rijt-Plooij and Plooij, 1993), and in comparison with measurements indicating how head circumference changes in the same period of infancy (Fischer and Rose, 1994), the data indicate that changes in the infants' brain and communicative behaviour may influence parents' imitations. This hypothesis will be directly examined by forthcoming analysis of developmental changes in the imitations made by the *infants* in Kokkinaki's tapes. Altogether the results of this study give clear indication that in playful engagements, in Crete at least, both parties, infants and parents (and this means mothers *and* fathers)

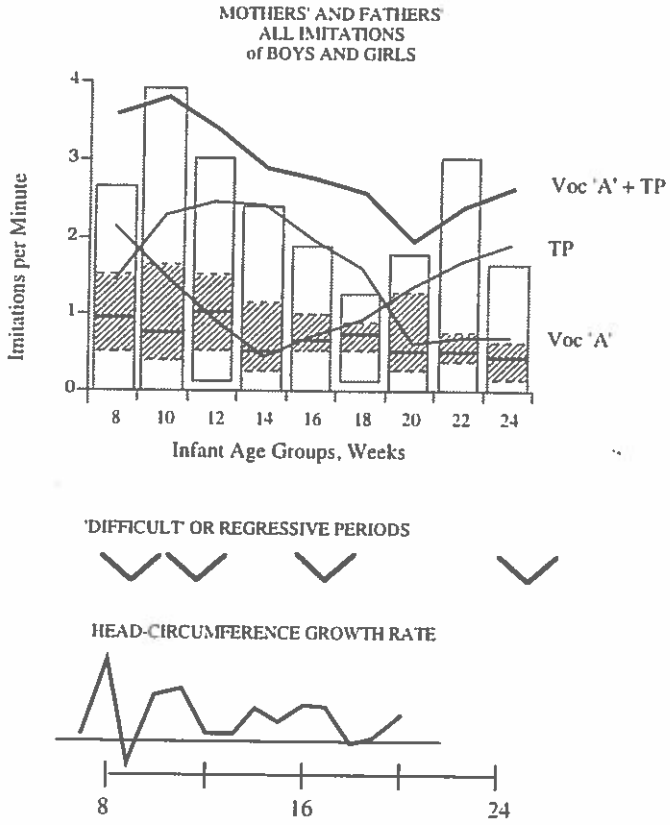

Figure 5.7. All imitations by parents, fathers and mothers, combined for all families, with boys and with girls. The relative frequency of imitative responses of two kinds, tongue protrusion (TP) and a vowel sound (Voc 'A'), obtained by Kugiumutzakis (1985, 1997) in his recordings of babies in Crete are shown, as well as the sum of these two frequencies, to obtain an indication of the overall imitativeness of the infants for these expressions.

contribute to the regulation of imitative communication that is truly intersubjective.

Imitation in different relationships, II: infants imitating infants

The greater part of work done in the last years on imitation is focused on mother–infant and child–child imitation. Experimental studies of infants'

ability to imitate adults have multiplied, especially around the controversy about the reality and nature of neonatal imitation. There are also many studies of imitation between toddlers and older children, but few of infants' imitations of other infants. If we want to fully understand the intrinsic capacities of infants to initiate communication in a mutually emotional way, the best strategy would seem to be to observe how they react to strangers of the same age as themselves, who have no language, and no cultural stereotypes or conventions. This would prove how much a communicating infant needs 'scaffolding' from an older, more mature, more culturally experienced and speaking partner.

It has often been asserted that the apparent abilities of infants to reciprocate in conversation-like exchanges are in reality 'random' and 'unintentional'; the appearance of reciprocity is essentially the result of the mother filling in, extending and interpreting rather aimless and undifferentiated actions of their babies not 'meant' as communications. On the other hand, detailed descriptions of the efficiency and appropriateness of infants' responses to familiar adults, and especially studies of the emotion-rich efforts infants make to call attention or to avoid after the contact with an adult is perturbed or interrupted, have led to the conclusion that they are born well-motivated to play an active, emotionally charged and discriminating role in interaction with sympathetic human partners (Beebe, 1982; Beebe et al., 1985; Murray and Trevarthen, 1985; Reddy, Hay, Murray and Trevarthen, 1997; Stern, 1974, 1985; Trevarthen, 1979, 1984; Tronick, 1982, 1989; Tronick, Als, Adamson, Wise and Brazelton, 1978, 1980; Weinberg and Tronick, 1994). Of course, the main difference between the infant and an adult partner is that the latter is likely to be talking. Given that the infant is not understanding the semantic content of speech and yet is reacting in a sympathetic and effective manner to qualities of the partner's expression in many forms, it is possible that similarly motivated infant–infant interactions will occur by non-verbal means.

A number of studies have recorded interactions between infants over 6 months of age. For example, these have investigated imitation (Hanna and Meltzoff, 1993; Patrick and Richman, 1985), differences between mother–infant and infant–infant interactions (Adamson and Bakeman, 1985), the effect of the presence of toys (Hay, Nash and Pedersen, 1983; Vandell, Wilson and Buchanan, 1980) and the differences between reactions to familiar and unfamiliar peers (Jacobson, 1981). It appears that, in this age range, infants who are strangers to each other are often wary and avoid one another at first, but, in spite of this suspicious reaction, negotiated play is soon enjoyed, with mutual sensitivity of responses. Mutual touching, as a positive response by 6-month-olds to one another, may be

inhibited by the presence of toys, but a toy may become more interesting if it is held by a peer, especially for a boy (Hay et al., 1983). One-year-olds point to, show and offer toys to one another (Hay, Caplan, Castle and Stimson, 1991). It would appear that at this age peer interactions do indeed have many of the features of infants' interactions with adults.

Apart from investigations of 'contagious crying' between young infants and the different reactions of newborns to recordings of their own crying (Hay, Nash and Pedersen, 1981; Martin and Clark, 1982; Sagi and Hoffman, 1976; Simner, 1971) and one study of how pairs of infants 1 to 3 months old interact when seated confronting one another on their mothers' laps (Fogel, 1979), there has been no analysis of the earliest possible face-to-face exchanges between peers. There has been one comparison of young infants' reactions to peers with how they respond to the reflection of themselves in a mirror (Field, 1979).

Although the above studies report only diffuse animation or quiet attending, and not the subtleties described for mother–infant proto-conversations, the evidence we do have indicates that infant–infant interaction could be a way of testing the idea that infants naturally regard other humans of any age as potential partners in an emotionally charged communication game, and that they can communicate feelings and interpersonal initiatives without the aid of mothers or toys. Observations by Reddy (1992) of how a 3-month-old, who is familiar with the mirror-image, behaves in front of the mirror indicate that a rich playfulness is possible with a reflected self. It seems to us that meetings with peers must be a common event in everyday life of many infants, and we expect they are of some interest to them.

We have begun a study of how pairs of infants at between 5 and 9 months use immediate or repeated imitation as a means of communicating. This is preparatory to studies of even younger subjects' interactions. Infants were brought by their mothers to the laboratory and placed in front of one another in their push-chairs. Their behaviour is recorded with the aid of two video cameras and a split-image generator that gives us a picture of the two infants side-by-side on one monitor, with sound. We are beginning a computer-assisted microanalysis of the behaviours of the two infants, measuring their timing. The babies readily start a *conversation of movements* in which imitations play a conspicuous part. As the interaction progresses, they take turns and then we can observe a nicely patterned dance involving initiatives by both infants.

Take, for example, two 8-month-old infants, a boy and a girl. They have never met before and are seated in their push-chairs, facing each other. Suddenly, while they look at each other the boy starts to kick his foot up and down and the girl imitates him immediately. He kicks back and she

does the same, but she also vocalises, smiles and points at him. He is absolutely stunned by the presence of another infant in front of him who is behaving in this obviously friendly way. Reciprocal expressive behaviours while the infants are gazing at one another, like this, are typical of our corpus. Another interesting phenomenon in the infant's communication is *synchronisation between matching behaviours*. They do the same movements with their bodies at precisely the same time. In the above example, in 1 minute of interaction, there were 2 successive imitations and 5 synchronisations.

Imitation can be used *to keep the 'movement-conversation' going*, as in the case of two 9-month-old infants, a girl and a boy. He, like the previous boy, kicks and moves his legs up high while looking at the girl, and she imitates him, but not with the exactly matching body movement; first, because she is not as mobile as he is (he can put his legs in a higher position than she can) and also because as he kicks he vocalises in a long and loud way (Tarzan-like), while she smiles at him. As his attention shifts to other things, like investigating his push-chair screws, she tries to re-call his attention by repeating the movement she imitated before, kicking and moving her legs up while looking intently at him. She succeeds – he looks back, imitates her kick and emits his 'Tarzan' call again.

Imitation may serve to express *recognition and pleased sympathy*. With two other 9-month-old infants, a boy and a girl, he looks at her, vocalises an 'a-haa' sound and waves his hand, jumping in his push-chair. She smiles at him and waves back, vocalising a 'uu' sound. He laughs at her and waves back again.

Imitation may also be used to *tease* the other. Another 9-month-old pair, a boy and a girl, shared interest in a toy which he is holding in his hand. He keeps shaking the toy, holding it out in front of her, and she imitates his hand movements, and vocalises 'uu', pointing as well. He jumps and shakes the toy again, as she tries to reach it. He evidently is finding pleasure in provoking her fruitless efforts.

We note that the timing of these interactions is well controlled and different pairs express themselves and respond in closely similar rhythms.

Imitation in different relationships, III: infants and mirrors

Reddy (1991; Reddy et al., 1997) has recorded that playful reactions may be provoked by infants seeing their mirror-images as young as 3 months. Zazzo (1957, 1993) made similar observations in his extensive studies of the reactions of infants and young children to mirrors. We

have made recordings of older infants reacting to a mirror box in which a TV camera facing the infant is concealed behind the partially silvered glass front. In this mirror, self-imitation is used for play, which is apparently provoked by the infant's awareness of the reflection of him- or herself, and the surface of the mirror becomes a toy. One 9-month-old boy looks at the mirror, shakes his mug and smiles to his image, and then, still smiling, hits the mirror with his mug. A 9-month-old girl, who is sitting on the floor facing the mirror, starts to make a series of kiss-like pouts, and then increases the speed of them and smiles, until she is really sending kisses. After that, still smiling and kissing, she makes jumping movements with her bottom and moves her arms up and down, apparently feeling a great pleasure in doing so while watching her image. In many cases, the infants are obviously 'showing off' self-expression with the 'mirror other'.

Infants also used self-imitation as a means of *self-recognition* or *self-exploration*, as in the example of a 7-month-old boy, who waved to the mirror, then, recognising the hand as his, looked directly at it while moving it in front of his eyes. There have, of course, been many experimental studies aimed at determining when infants see the mirror-image as a representation of themselves, 'self-awareness' being conceived as a developmental outcome of experience with the sensory feed-back effects of acting (Lewis and Brooks-Gunn, 1979; Rochat, 1995). We have taken more interest in the impersonations of social interactions that mirrors stimulate.

Conclusions and a model: imitations are driven by sympathetic fluctuations in motives that regulate the balance of initiative in intersubjective encounters

The studies we have reviewed, and the new results we have presented, show that infants are born ready to reciprocate in rhythmic engagements with the motives of sympathetic partners, and that imitations are made communicatively, as part of this mutual, reciprocal involvement. Expressive acts are reproduced as responses. They carry a message of acceptance or interest and take place in a sequence of behaviours that exhibit precise temporal patterning, with synchronisations and turn taking. What can we infer about the motive processes of intersubjectivity in humans from this data?

Figure 5.8 shows an analysis of the rhythms of a Scottish mother's song in English. Her infant showed rapt attention to her performance, and moved and vocalised with sympathetic attunement. The baby concentrated vocalisations on the protracted vowels with which the mother

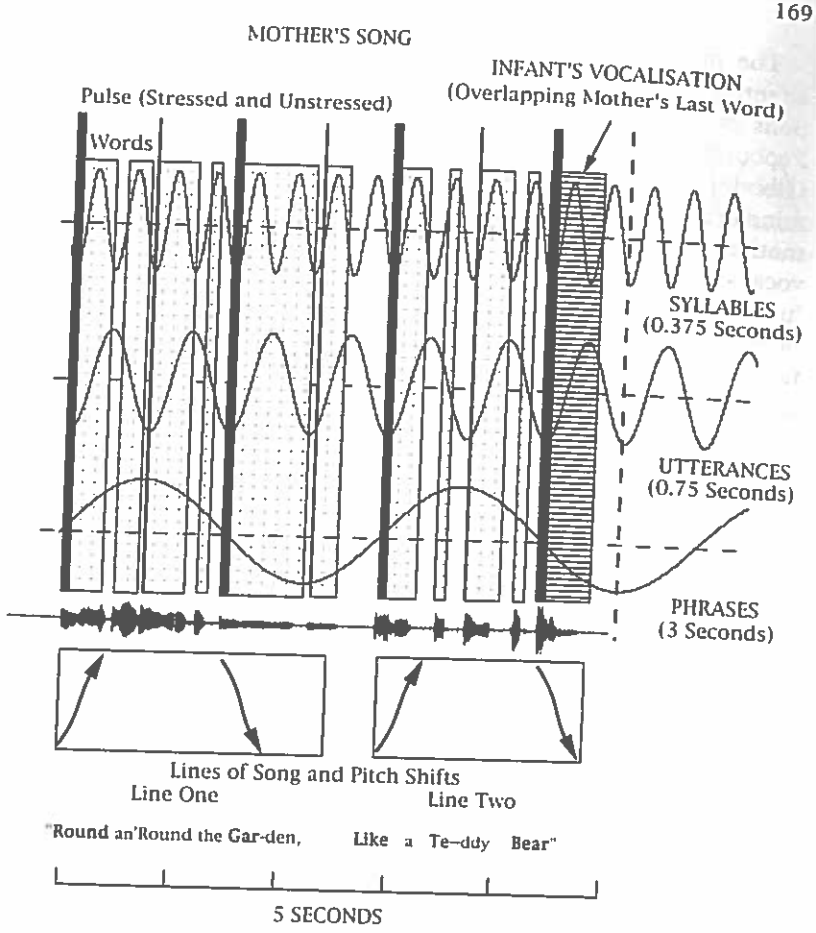

Figure 5.8. Rhythms of the baby song 'Round and round the garden'. Mono and bisyllabic words in the text are shown in the microphone signal immediately above the boxes in which major pitch shifts are indicated. Each 2-and-a-half second musical phrase (or line of the verse) has a rise and a fall of pitch, and four utterances (beats), which are alternately stressed and unstressed. The infant vocalises on the last syllable (see Figure 5.4), and this rhymes with the final syllable of the song, which ends, 'One step, two step; And a tickly under there!'

ended her phrase pairs, the second and fourth lines of her song. The baby thus demonstrated sensitivity to the rhythmic 'structure' or 'syntax' of the song and its 'semantic emphasis' or points of high significance, in direct reflection of the dynamic motives mother and infant were experiencing together.

The prominence of the rhythmic synchrony, which has drawn the attention of all who have made sufficiently detailed microanalytic descriptions of mother–infant interactions (Beebe, 1982; Beebe et al., 1985; Papoušek and Papoušek, 1981, 1987, 1989; Stern et al., 1977; Stern and Gibbon, 1980; Trevarthen, 1979, 1993a, b), appears to show that the mind of an infant is endowed with a mechanism that causes oscillations in motives at certain preferred intervals. Three periodicities manifest in vocalisations, which, following Lynch et al. (1995) we will call 'syllables', 'utterances' and 'phrases', seem to be of cardinal importance in all forms of expression. We propose that each of these represents a phasic alternation of the intrinsic motives between an active state of 'assertive' effort and a more receptive state of 'apprehension', in which activity is reduced in favour of reception and concentrated around organs that are engaged in taking in and 'processing' information from the environment. In an intersubjective encounter, this means that in each subject assertive expression alternates with apprehensive attending, and the two subjects either alternate or synchronise these phases between them. Imitations, we would propose, occur at one place in alternation, when assertiveness of one subject is waning, and the other is still highly apprehensive or acceptive.

This idea is diagrammed in Figure 5.9. We would predict that, in conversations between humans, and other kinds of co-operative voluntary behaviour, a rhythmic pattern of expressions will be displayed. Generally vocal or verbal imitations, sounds of agreement (such as 'uhuh'), eyebrow raising, nods, smiles. etc. will be fitted in between declarative or assertive speech turns with their gestural accompaniments. Changes in eye contact should also be coupled to the same motive fluctuations.

In 'motherese', rhythmic games, nonsense chants and baby songs, the parent is mirroring the manifestations of these rhythms in the baby, encouraging the infant's participation. Our analyses confirm that infants begin life highly sensitive to the periodic expressions of other persons, and that they are born skilled in reacting with rhythmic 'attunement' to the patterns of 'emotional narrative' that are produced. The rhythms of a Scottish mother singing 'Round and round the garden' with her 5-month-old, and the baby's musical collaboration by vocalising on the final syllable of the second line, are demonstrated in Figure 5.8.

Kokkinaki has, as presented above, shown that fathers can join in these games as well as mothers. Fiamenghi (above, and 1997) confirms that infants can set up rhythmic intersubjective play with other same-age infants, even before 6 months. In forthcoming work, we will be examining communications between much younger infants, and we will be extending the study of fathers' imitations to a population of Scottish families matched with those in Crete.

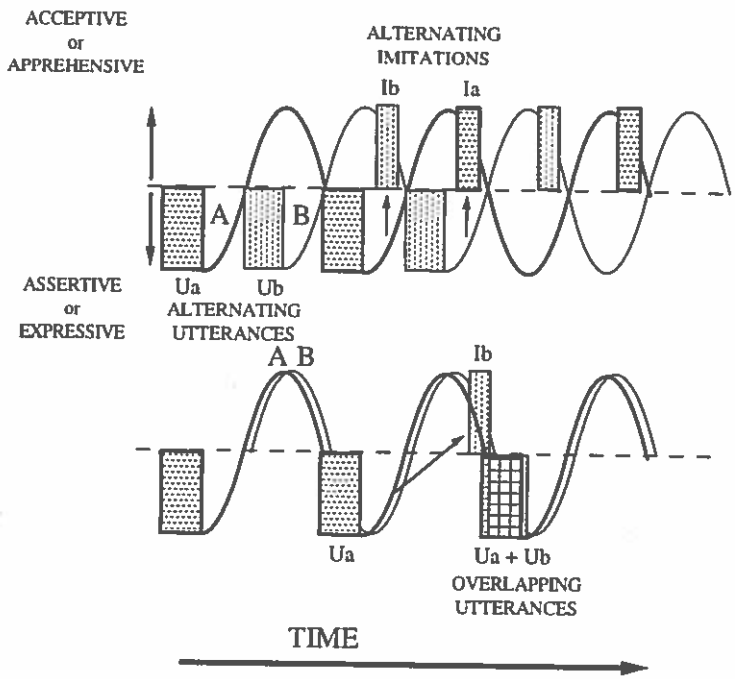

Figure 5.9. Motive fluctuations and their engagements between two subjects in communication. Utterances (U), or other periodic expressions, occur as assertiveness is increasing and cease as the motive for assertion falls. Imitations (I) are triggered in the other subject when the utterer has started to lose assertion and is becoming more apprehensive or acceptive. They may be followed immediately by an utterance from the second subject who thus takes a turn. Synchronisation of utterances may be set up (below) when one subject (B) tracks the expressive pulses of the other subject (A), imitates (Ib) and immediately makes an utterance (Ub overlapping Ua).

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NOTES

Rizzolatti and Arbib cite 'mirror neurons' in monkey frontal cortex as evidence for pyschological matching of perceived external events to internally generated actions, or observer to actor, and find PET scan evidence for a mirror system for gesture recognition in Broca's area of humans that links 'doing' with 'communicating', actor and observer and sender and receiver of messages (Rizzolatti, G. and Arbib, M. A. (1998). Language within our grasp. *Trends in Neuroscience*, 21, 188–94).

1 In his recent book on 'The Culture of Education', Jerome Bruner (1996) proposes that the future of educational theory lies in a better comprehension of its intersubjective nature. Awareness of culturally defined objects, tasks and manners is alive in infants at one year, and eagerly shared (Trevarthen, 1988, 1992).

2 We considered the significance of reciprocal imitations between mothers and infants in protoconversations first in response to a presentation by Olga Maratos of her pioneering study of imitation in early infancy (Maratos, 1973; Trevarthen, 1974).

3 This can be true of creative thought even at its highest level of complexity. Einstein reported to Hadamard (1945) that his mathematical invention was initially in the form of 'sensations of bodily movement', and that formal 'symbolising' was a difficult later stage. The converse imaginative ability to *become something else*, the embodiment of an object or event of interest, i.e., to move from objective awareness to subjective awareness, is what we understand Merlin Donald (1991) to mean by 'mimesis', and we accept his estimate of its central importance in the evolution of representational processes in the human mind, and their communication.

4 Wallon's theory of imitation emphasised this reciprocity (Wallon, 1970), which is documented and analysed developmentally in Nadel's studies of the functions of immediate imitation in the play of toddlers (Nadel-Brulfert and Baudonniere, 1982; Nadel, 1986; Nadel and Pezé, 1993).

5 It is of interest that the ability to imitate hand presentations in the same form as another person intends them is confused in autism. Autistic children, when they are asked to perform this kind of imitation, often make 'ego-centric' ('perceptual') rather than 'allo-centric' ('intersubjective') reproductions of hand postures. They match what they see, failing to mirror the orientation of the hands as if they were in the place of the other person (Ohta, 1987).

6 Piaget (1966) acknowledged the place of rhythm 'at the junction of organic and mental life' in the earliest 'sensations' and he observed that, 'rhythm . . . involves a way of linking elements together which already heralds an elementary form of what appears as the reversibility characteristic of higher mental processes'. Donald (1991, p. 186), recognising the communicative significance of human moving, makes the very different claim that rhythm is a special feature of human *expressive* behaviour, and central to human mimesis. He says: 'Rhythm is an integrative mimetic skill relating to both verbal and visuomotor mimesis. Rhythm is a uniquely human attribute; no other creature spontaneously tracks and imitates rhythms in the way humans do, without training. Rhythmic ability is supramodal; that is, once a rhythm is established, it may be played out with any motor modality, including the hands, feet, head, mouth or the whole body . . . Rhythm is therefore evidence of a central mimetic controller that can track various movement modalities *simultaneously* and in parallel.' Here are two different definitions of rhythm.

7 Unpublished research for Doctoral Thesis, University of Edinburgh. The thesis, completed in 1998, also includes data from a matching sample of families in Edinburgh, Scotland.

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