

Structure and Dynamics of Human Communication at the Beginning of Life*

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Summary. Although the beginning of postpartum social integration and communication has been long viewed as relevant to psychiatric theories, early parent-infant communication has become a matter of scientific investigation only recently. The present survey explains the significance of an approach based upon the general systems theory and explores to what extent the early parent-infant interaction can function as a didactic system to support the development of thought and speech. Evidence of this function has been found in those forms of parental behavior that escape the parent's conscious awareness and control, as exemplified in the vocal communication with presyllabic infants. Parents unknowingly adjust the structure and dynamics of speech to the constraints of infant capacities, detach prosodic musicality from lexical structure, and use it in particularly expressive forms for the delivery of the first prototypical messages. In this and other similar ways, parents offer an abundance of learning situations in which infants can try out various integrative operations.

A biological rather than cultural provenience of the support of communicative development indicates a potential relevance for the interpretation of speech evolution. In addition to qualities of the vocal tract and to complex symbolic capacities in humans, the early intuitive support of communicative development and its playful character are suggested as species-specific determinants of speech evolution. Implications for clinical research are suggested.

Key words: Infancy psychiatry – Parent-infant interaction – Preverbal vocalization – Parental speech to infants – Intuitive parental didactics

Introduction

The means and forms of human communication have long been a matter of psychiatric interest since they typically deviate in classic psychiatric diseases, for instance, in manic-depressive psychosis, and have been acknowledged as relevant determinants of healthy mental development. Preventive psychiatry, therefore, has paid increasing attention to the de-

velopmental process of social communication and integration. However, attention has not evenly covered all developmental periods, and in fact the preverbal period of infancy has remained rather neglected. This neglect may partly be due to the fact that infant psychiatry has only recently become a sub-discipline of psychiatry. The neglect partially mirrors a similar lack of interest in early developmental stages in other disciplines, such as in linguistics, where the main attention has focussed on verbal communication starting around the age of 1 year or later.

Researchers can easily feel helpless when listening to the vocal communication between preverbal infants and caregivers; much of it seems to be incidental, unpredictable, nonsensical, and is very difficult to assess with linguistic or phonetic measures. Any consideration of the influence of early vocal expressions on later speech acquisition has been highly speculative until very recently. Similar difficulties have concerned the first 2 or 3 postpartum months in particular since even the production of first syllables starts during the second trimester postpartum. At first glance, 0-to-3-month-old infants seem to lack the capacity either to produce interesting vocal sounds or to perceive and adequately process vocal sounds produced by caregivers.

Conversely, however, research on animal and human infants deprived of maternal care has clearly indicated severe disturbances in social communication caused by the absence of adequate caregivers. In addition to this discrepancy, the seemingly random character of vocal utterances at this early age is contradicted by one of the laws in biological development stating that the less differentiated is the organism's structure the more predictable is its behavior.

Considering the complexity of approaches to early social communication it is not surprising that psychiatrists invite a developmental psychobiologist to critically review the concepts on this problem and to investigate more thoroughly the beginning of social communication in infants still resembling nonhuman rather than human primates. A similar decision in Professor Ploog's case, however, was embedded in his general effort to enrich psychiatric research with relevant biological approaches, and also offered the present authors a challenge difficult to resist. Today it may still be too early for a conclusive report, but this nevertheless provides a convenient opportunity to review the present state of the art and to delineate directions for further research.

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Parent-Infant Communication as an Organismic Interactional System

We find it useful to first consider parent-infant communication from the "bird's-eye view" of general systems theory, since such a view has made us aware of several problematic aspects (Papoušek and Papoušek 1982a).

First, observers of living communicative systems should take into account all changes that constantly occur with time in organismic systems, changes which occur due to genetic determinants, environmental conditions, and mutual interdependence between communicating individuals (von Bertalanffy 1968). Consequently, neither the infant nor the caregiver should be seen as stable structures but rather as variable, dynamic systems. Such a concept may be very obvious in the case of the rapidly growing infant but less obvious in the case of the caregiver; and yet, the mother of a newborn, for instance, is a different individual than she was during pregnancy or is going to be 3 months after delivery.

Second, early parent-infant communication occurs during social interactions and not at all during mere Stimulus-Response (S-R) situations. Therefore, the S-R types of analyses are not applicable in this case, although in many studies mothers have been considered as stimulators and infants as mere responders. In fact interactive behavior represents both answers and stimuli simultaneously as is typical in dialectic dialogues. A particular problem arises if we attempt to assess interindividual variability under these circumstances. The observer has to introduce new experimental designs rather than apply statistical procedures designed to assess interindividual variability in S-R models.

Third, it is particularly difficult to define communicative behavior in human studies unless a narrow class of items is selected apodictically. If it is true in the theory of informatics that the content of information primarily depends on the capacity of the receiver rather than on the capacity of the emitter, then the capacity to observe and interpret perceived information in human receivers makes it possible that any behavior observable during social interactions may have a communicative meaning. For instance, not only every vocal sound but also a pause in vocal utterances can mean something in human communication. The capacity to read the meaning of environmental events, i.e., to perceive and process, for instance, observable behavioral cues, develops near the beginning of postpartum life in human infants, earlier than motor skills necessary for the performance of intentional communication.

Fourth, the category of intentional communication, so rich in humans, still represents only a part of the communication detectable in Nature – in the broader biological sense. Therefore, even if it may be questionable to decide at what age infants start communicating intentionally, it is not questionable that much of the early communication may take place at other biological levels of nonintentional communication. A surprisingly large proportion of relevant nonintentional, intuitive components on the parental side of interchanges has been one of the major findings in our own studies on early communication.

Last but not least, parent-infant interactions are characterized by a polar difference between parents and infants in their capacities to integrate experience and to communicate about it verbally, as well as in the amount of experience stored

in memory. This difference may give the early parent-infant communication a didactic meaning provided the more competent and experienced individual is motivated to share knowledge, and less competent and inexperienced one is motivated to acquire new knowledge.

Implications of the above five aspects of general systems theory appear to be far from speculative; they have raised relevant questions related to early parent-infant communication, and have pointed out new methodological approaches. We have learned to view early vocal communication as part of a broad spectrum of communicative behavior included in social interactions, with the assumption that social interaction is defined as any form of interaction between two conspecifics and communicative behavior as any form of observable behavior during social interactions.

Rather than focussing merely on a narrow set of behavioral and vocal items as other authors in most previous studies, we have strived for a complex, objective documentation of interactions, at least audiovisually, in order to be able to investigate them microanalytically and independently of previous categories of communicative repertoire.

Starting with analyses of spontaneous mother-infant interactions in home settings, we have secondarily designed experimental verifications wherever the initial analyses had made us aware of novel communicative behavior calling for novel partial hypotheses. Simple S-R models have often been used for such purposes, for instance, for testing the effectiveness of detected behavioral cues. At other times, however, special complex designs have been used, such as interdyadic alternations of mothers, for the purpose of analyzing interindividual variability in communicating partners and separating its role from the roles of environmental factors and interactional contexts. It has also proven useful to record infant monologues in addition to their dialogues with caregivers in order to assess the infant's vocal competence.

Assuming that caregivers may be increasingly attentive and responsive to infant gestures and facial expressions before infant vocalization becomes sufficiently differentiated, we have also tried to analyze interrelations between vocal and nonvocal forms of communication, including nonintentional forms. Namely, it soon became evident that parents were unaware of much of their communicative behavior in spite of an obvious relevance of that behavior to the developmental process of social communication. Interestingly, such intuitive behavior, carried out by parents unknowingly, has been found by us to include potential didactic interventions and become a matter of special attention. The fact that they escape parental attention may also explain why they had been neglected in many previous studies of parental behavior, particularly in those investigating parental interventions with the help of mere questionnaires.

Two other research avenues, parallel to ours, have influenced our own studies conceptually. First, the comparative research on animal communication has nourished our interest in the evolution of speech and our hope that a better understanding of speech ontogeny might contribute to the interpretation of speech phylogeny (Papoušek and Papoušek 1985). Second, the research on the development of infant learning and cognitive abilities – a topic of our own earlier studies – has motivated our interest since it has become obvious that the infant's social environment represents the main source of learning situations, far outweighing the limited sources present in nonsocial environments (Papoušek et al. 1985).

In this presentation, we shall attempt to summarize our studies with respect to the two research avenues just mentioned, and to comment on the following aspects: the structure and dynamics of early vocal communication; the contribution of early communication to the development of infant integrative competence; the significance of new findings for the concept of speech evolution; the significance for developmental psychiatry.

The Structure and Dynamics of Early Vocal Communication

The vocal repertoire of the newborn is restricted to the cry and to relatively rare, simple other sounds. The newborn cannot yet control breathing sufficiently enough to prolong expirium for modulating vocal sounds, with the exception of the cry. The fundamental vowel-like voicing, produced by infants occasionally during social interactions are superimposed on the momentary type of breathing, and thus may sound like short rhythmical utterances without any communicative adjustment. However, the parent may learn something about the infant's behavioral-emotional state inasmuch as the rate of breathing as evidenced in the rhythm of vocal sounds depends on the infant's state.

The next step in vocal development includes: a gradual prolongation of quiet vocal sounds due to the developing control of respiration; modulation in pitch of quiet sounds; and a gradual transition from fundamental voicing to euphonic sounds resembling musical tones and perceived by parents as "cooing". Pitch modulations appear either as melodic transitions in pitch or sometimes as one-hit imitations of the pitch produced by the caregiver as reported by us in 2-month-old infants.

Several features of speech in caregivers change strikingly when caregivers start talking to infants. These changes interestingly relate to the features of infant presyllabic vocalization. Both biological parents and strange caregivers, children included, tend to talk to newborns or young infants and to attract the infant's visual attention (Fernald and Simon 1984; Papoušek and Papoušek 1982b; Rheingold and Adams 1980). The speech registers offered to presyllabic infants are characterized by syntactic simplicity; segmentation; slow tempo; a limited repertoire of simplified, highly repetitive patterns of expressive melodic patterns that are characterized by enhanced pitch excursions and overall rise in pitch (Fernald and Simon 1984; Papoušek and Papoušek 1981; Stern et al. (1982).

Recent comparisons of maternal and paternal babytalk (Jacobson et al. 1983; Papoušek et al. 1985; Warren-Leubecker and Bohannon 1984) have revealed that the tendency to adjust speech in the above sense is universal across sex. In addition to expressive musicality in the prosody of babytalk, the prosodic envelopes, so firmly tied to lexical content in adult-adult dialogues, become independent of lexical content in babytalk. In contrast, they become tied to interactional context and the infant's behavioral-emotional state in parent-infant dialogues (Papoušek et al. 1985).

Thus the prosodic envelopes serve very different functions in babytalk as opposed to their functions in adult-adult dialogues. Parents may, for instance, ask questions and answer them; however, instead of using prosodic contours typical of adult questions and answers they use expressive contours related to parental tendencies to arouse, praise, soothe, or lullaby the infant. According to Papoušek et al. (1985), it is not

the lexical but the prosodic message that plays the dominant role and represents the first prototypical message offered in the speech to presyllabic infants. Again, the entire adjustment of adult speech during interchanges with presyllabic infants occurs unknowingly in parents; however, if rational didactic recommendations were to be prepared in support of the infants' vocal development, they would hardly differ from these same intuitive didactic adjustments already made by parents.

The didactic character of intuitive parental interventions becomes particularly obvious during the production of the infant's first consonants and syllables. The infant may only incidentally produce a consonant-like sound and yet, the parent tends to support further elaboration and improvement of the novel capacity, displaying abundant, phonologically correct and expressive examples and rewarding the infant for every imitation. As soon as the infant improves the control of respiration so as to fraction one voiced expirium with the help of consonants and to produce repetitive syllables, a novel strategy appears in parental interventions — a tendency to treat repetitive syllables as potential protowords, to assign them a semantic meaning, and to teach the infant by using such protowords for naming the most relevant environmental objects or events. Obviously, didactic interventions mainly concern procedural types of information rather than data-based information, and support first the production of vocal patterns rather than the acquisition of a lexical vocabulary.

The Contribution of Early Social Communication to the Development of Infant Integrative Capacities

Extensive infancy research has, during the last two decades, verified that infants are capable of the main integrative operations near the beginning of postpartum life, albeit not yet in verbal and self-conscious forms. Presyllabic infants respond to contingent environmental events with instrumental learning, extinguish or relearn adaptive responses in accordance with changing environmental conditions, are capable of detecting regularities or rules in more complex contingencies and applying newly acquired concepts in behavioral adaptations (Papoušek 1977; Sameroff and Cavanaugh 1979). Presyllabic infants also learn associative relations between conditioning signals and reinforcements (Janoš 1959; Lipsitt 1982), imitate facial behavior (Meltzoff 1981; Meltzoff and Moore 1977) and vocal sounds (Papoušek and Papoušek 1982c). They perceive categorically, respond differentially to visual symmetry, and are able to integrate perception and exploratory experiences across sensory modalities (Papoušek 1977).

The evidence regarding infant integrative capacities has been obtained almost exclusively in laboratory settings, and little attention has been paid to individual differences and developmental changes in these capacities, or to their dependence on environmental factors. The latter interest seems to have been inhibited by two arguments: first, that there has been no evidence for didactic interventions in the cultural history of care for young infants; and second, that all that might be learned during infancy gets lost anyway due to infantile amnesia. We have opposed these arguments as one-sided since they have considered only consciously-conveyed cultural traditions and only data-based information stored in infant memory. We have recommended instead extending such studies to the intuitive forms of parental care for infants, and

taking into account the storing of procedural information by the infant.

There is evidence now that data-based information ("knowing what") and procedure-based information ("knowing how") are stored and/or affected by amnesia in different ways. For instance, adult patients suffering from the Korsakoff type of amnesia are unable to retain data-based information but do retain procedure-based information. In our own studies (Papoušek 1977; Papoušek and Papoušek 1984), we have shown that infants can learn how to learn and that they learn faster with age. We have also shown the abundance of learning situations that are embedded in infants' social interactions as compared with other environmental situations. A regular and vivid participation of emotional and communicative behavior, reported by us to regularly accompany the course of integrative operations in infants, seems to us to indicate the infant's strong motivation to acquire knowledge of and control over environmental events (Papoušek 1967, 1977).

Parents are obviously attentive observers of their infants, and according to frequent comments in babytalk, they strive to find out the extent to which infants perceive and process what parents display. Parental tendencies to intervene didactically, albeit unknowingly, and their pleasure over the infant's success in naturalistic learning indicates that parents are intrinsically motivated to share experience and knowledge (Papoušek and Papoušek 1984).

The microanalysis of parent-infant communication reveals plenty of short episodes in which parents very regularly and expressively respond to infants' communicative attempts. Parents respond with striking "greetings" to the achievement of a direct visual, "eye-to-eye" contact; with differential, multimodal patterns – encouraging, praising, or soothing – to infant vocalization or facial expressions; and later they respond with pointing, naming and contact mediation to infants' expressions of attention and interest in surrounding objects. Thus, parents make themselves contingent, manipulatable and predictable; in the same vein they support the formation of the first infantile concepts and the acquisition of the first communicative skills through instrumental or observational learning, elementary cognition, imitation, and communicative symbolization. The abundant challenge to try out integrative operations seems again to serve the procedural aspects of cognition: it may facilitate a faster and more efficient use of integrative operations before brain development allows the verbal child to profit from data-based information and also from formal, rational didactics.

In our view, a particular significance has been attributed to the elements of playfulness and creativity in parent-infant interchanges (Papoušek and Papoušek 1981). To define play and to outline its essence seems to be hardly possible with respect to its many facets. However, thinking of the reasons why play has been considered as one of the determinants of human culture (Huizinga 1955) and as a potent didactic tool (Comenius, 1657), we have realized that parents not only repeat their stimulations but also modify them partially as soon as the infant seems to be bored and stops attending. Some parents are very innovative in this respect, and some infants respond with very vivid attention and eventually with signs of pleasure to such innovations. According to our hypothesis, parental intervention may support the development of a capacity not only to acquire a concept of novel events and thus to reduce the stress from too much novelty but also to reopen the concept and to

enrich it if the event becomes too familiar, to avoid the stress of boredom. Playfulness in our terms is parallel to later avenues of creativity, humor, and scientific innovation – the main avenues of human culture.

Contribution to Speech Evolution

A good understanding of the ontogeny of speech helps interpret the phylogeny of speech as well, not because ontogeny should recapitulate phylogeny but because the study of speech ontogeny is one available way for revealing the crucial determinants which should be considered in comparative research. The evidence of early integrative capacities has necessitated a correction in the former assumption that processes of thought in humans are determined by the acquisition of speech. Nowadays, it is assumed that concept formation, abstraction and symbolization must reach a certain level first in order to allow the acquisition of speech (Papoušek 1977).

The human infant may be precocious in the development of the integrative prerequisites of speech, however, these prerequisites – at least in elementary forms – need not be species-specific capacities of man. Chimpanzees, for instance, reach a sufficient level of abstraction and symbolization to acquire a sign language, although they lack the anatomical and physiological qualities of the vocal tract which allow the production and rich modification of voice in man. Conversely, some birds have the necessary vocal tract tool but lack the complexity of thought and culture in higher primates.

Thus humans seem to possess an advantageous combination of capabilities which, in general, are present separately in various animal species as well. With respect to the present knowledge on early parent-infant communication, it is necessary to question the assumption that the evolution of integrative capacities and vocal tract alone can explain speech evolution. We suggest that an early didactic support of the infant's communicative development in general, and vocal play in particular should also be considered and systematically examined as additional determinants of speech evolution in man.

The Significance of Early Communication for Mental Health

Human communication in its manifold forms doubtlessly belongs to species-specific means of adaptation that allowed not only the development of cultural achievements but also a many-sided biological adaptation and demographic propagation. It is, therefore, explainable that evolution might have favored a selection of social interventions for the support of communicative development. As is true about most relevant means of biological adaptation in general, and in the case of human communication, too, such support has been found to be abundant, rather universal, determined genetically to a large extent, and emerging early during ontogeny. These criteria have been met in the intuitive parental support of speech development as far as this aspect has been investigated. Consequently, the clinical relevance of the proper development of early social communication seems to be doubtless, as well; however, to prove this relevance scientifically is a difficult task.

One problem results from the universality of intuitive parental interventions across age and sex, which makes it difficult to find cases which lack both parental interventions and

compensation by other members of the infant's social environment. Experimental separation of infants and exclusion of supportive interventions are not thinkable. The observations of communicative disorders in infants due to maternal deprivation do not allow conclusions on the role of intuitive forms of parenting since these forms were neither assessed, nor considered, in studies of maternal deprivation.

Although intuitive didactic interventions seem to be qualitatively homogeneous due to their universality, their quantity may be variable across social classes and cultures (Papoušek et al. 1985). For instance, lower-class mothers have been reported to talk less to infants than do middle-class mothers (Field and Pawlby 1980; Ninio 1980; Tulkin and Kagan 1972), and Indian mothers in Guatemala (Kagan and Klein 1973) or African mothers in Zambia (Goldberg 1977) talk less than American mothers.

Bornstein and Ruddy (1984) studied twins as a natural situation in which the availability of maternal didactics is usually reduced. At 4 months, each twin could dyadically interchange with the mother less than a half of the time available to singletons from a sociologically comparable population. Due to these deficits, speaking vocabularies were smaller and Bayley Scale scores lower in twins at 1 year than in singletons. Obviously, some evidence of the role of intuitive parenting could be accumulated from studies of either natural fluctuations in the quantity of parental interventions or deficits caused by clinical reasons, such as deafness, blindness, or manic-depressive disorders.

According to the authors' concept, successful parent-infant communication protects the dyads against disturbing influences from biological and sociocultural environments. Failures in dyadic communication may, however, cause a vicious circle and deteriorate the unfavorable environmental effects (Papoušek and Papoušek 1982a). The short history of studies on intuitive parental didactics has not yet provided direct evidence for the concepts presented. The necessary studies will require a noteworthy investment of effort and time, and represent one important direction for the further research on early social communication.

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