IS THERE A RELATION BETWEEN EATING AND LEARNING TO SPEAK?

An outline of research on mouth behaviour in infancy.

Kino Jansonius-Schultheiss

INTRODUCTION

A challenging question for further scientific research is the investigation, on the one hand, of the relationship between aspects of feeding behaviour in young infants in interaction with their caretakers and, on the other hand, the emergence of the non-vocal and vocal communication system in the child.
As several researchers in infant speech and pre-language have shown (Bullowa, 1979) communicative interest and ability are already present in the neonate. In the newborn child and its mother non-vocal and vocal messages are sent to each other in 'dialogues' of touching and feeling, smelling, tasting, looking and 'talking'. Through this kind of complex behaviour they are communicating with each other and are so developing one of the tools in the adaptation process of the child into the socio-cultural world of its parents (Bullowa, 1979). Especially in the intimacy of the feeding situation we can perceive patterns of communication, verbal and non-verbal: in the relaxed, tender situation of giving and receiving food the close body contact enables the mother to stroke and touch, to talk in a soft gentle voice, to watch the baby's reactions in drinking. The child is responding in a subtle way: if it isn't hungry any more, it can slow down its sucking rate and alter its rhythm, it can stop and look around, shake its head or spit out the nipple or teat. During the nursing the baby is gurgling and vocalizing. In the feeding process biologically (nature) determined behaviour is intrinsically interwoven with social and emotional (nurture) relevant behaviour. An important aspect in feeding is the development of mouth functions in drinking and later in eating.

The early feeding experiences may be highly relevant for the speech and language development of the child, but so are some other biologically determined aspects: the role of the organs of the mouth in the process of drinking and eating and their value later on in the process of speech motor production. Speech pathologists know by experience that there are a lot of speech production problems with a marked relation to parental feeding practices such as the prolonged use of soft food or drinking out of a bottle with a nipple (Jansonius-Schultheiss, Van Coppenolle & Beyaert, 1985). Therefore it is interesting to study these relationships in the very young, rapidly developing child more closely. In what way do the easy observable oral anatomic structures in the infant move such as the lips, the lower jaw, the tongue in the coordinated act of sucking and swallowing, biting and chewing. How does the mother in a more or less unconscious way stimulate certain oral behaviours in the oral patterns of her child. An important question to be answered is: is a smooth normal sensori-motor development concerning these primary mouth functions a prerequisite for later articulatory proficiency or not. If we can answer that problem, we

can perhaps get insight into the problem of delayed mouth function development in relation to delayed speech sound development. Sucking, swallowing, biting, chewing and other aspects in feeding are parts of a normal oropharyngeal development and so is speech. In pronouncing certain speech acts as /a/ or /t/ one can perceive similarities to non-speech movements in eating, e.g. respectively the up- and downward movements of the lower jaw in chewing and tongue tip elevation in swallowing. Can the milestones concerning speech sound productions in the first year of life as indicated by researchers such as Oller (1981) or Koopmans-Van Beinum & Van der Stelt (1979, 1981, 1985) be related to certain steps in the development of the mouth such as getting the first tooth, starting to chew? Using the mouth in different ways in feeding, in exploring the outer world with the mouth as tactile organ, in biting and sucking objects, in uttering vegetative and vocal sounds the child seems to map the 'geographic' properties of its mouth. The developing infant is orientating himself outwards but also inwards: in order to know how to use its mouth, how to exert certain movements and to get used to specific oral sensations, the structures and sensori-motor patterns of the mouth are to be learned.

FROM THE LITERATURE

It seems plausible to consider primary mouth behaviour a prerequisite for speech sound production, but objections against such an opinion are coming from the field of psychology and neurophysiology. Trevarthen (in Bullowa, 1979) made film and video recordings of face-to-face interaction between mother and one to three month old infant and showed lip and tongue movements, which he called 'pre-speech'. These expressions already exist at birth. They are more distinct in the second and third month. He suggests that these are already part of a specific speech mechanism. The movements are not related to specific moods or emotions: they are noticeable in a great variety of situations, in rest just as in happiness or anger. Trevarthen does not believe that these speechlike mouth activities are evolved from non-linguistic actions like oral reflexes or certain mouth patterns seen in drinking.
From the field of neurophysiology other remarks are heard. A central issue according to Netsell (1981, 1982) is the extent to which different units of behaviour are recruited for the various speech and vegetative motor tasks of the same musculoskeletal structures. He hypothesizes that specialized neuronal connectives and patterns of muscle activation are developed for the motor skills of speech. He believes that the temporal courses and eventual attainment of adult speech motor control are most dependent upon the individual's nervous system maturation. This neural maturation is a process of progressive organizations of functions and their morphological substrata into a functional system. Such a system is made up of a group of nervous system structures that develop an action specificity. In that way there is one functional system of neuroanatomic and neurophysiological elements subserving swallowing and another one subserving speech, sharing the same neuroanatomic structures or certain neurophysiologic aspects. These systems are said to develop on different times, according to the needs of the organism. Therefore, the functional system for swallowing and

other vegetative functions is developed in utero in order to be ready for the baby at birth to survive. The functional system for speech motor control, on the other hand, is not directly present at birth. Quoting Yakovlev (1962) in his explanation about the embryonic differentiation in human development Netsell (1981) holds the 'principal of the three-layered structure'. The neural and musculoskeletal elements that eventually comprise the speech mechanism have their body origins in the embryonic tissues of ectoderm, mesoderm and endoderm. Those of the vegetative movements however are only located in the mesoderm and endoderm. The neural controls are hypothesized to arise from the mantle (nuclear) and marginal (cortical) layers. The neural mechanisms serving vegetative movements originate primarily in the matrix and mantle layers. Although the speech and vegetative movements may share certain embryonic aspects, they have separate body and nervous origins in the embryo. Netsell considers this as first evidence against a hierarchical built speech sound development based on mouth movements in drinking and eating.

A second evidence against the notion of speech as 'overlaid' function on primary mouth function development is coming from the myelination studies. These show a centrifugal growth pattern of myelin, progressing headward and footward, mostly along a vertical axis and at different rates in particular areas. A vertical and a horizontal direction in myelinization can be noticed: the primary visual, motor, somatosensory and auditory cortices myelinate in a vertical order for 'hard-wiring' the long loop, fast-acting neural pathways, whereas the secondary and association areas myelinate in a horizontal plane as zones around these primary centres. Only these latter horizontal developments are regarded as critical to the eventual development of speech and language. They have no known role in the regulation of vegetative motions, according to Netsell.

In discussing the nature of speech and vegetative movements also the role of reflexes is questioned. The first types of speech motions and those in drinking and eating are stereotyped and automated. Some people tend to categorize both movement patterns as 'reflexive', while others share the opinion of inhibition of some vegetative reflexes in accomplishing normal speech movement patterns. Netsell argues that although the neural commands for speech and vegetative movements might share certain elements of schematic circuits of reflexivity, the command centres have different origins at some place in the nervous system: speech commands in the cerebral cortex, while vegetative movements are triggered from external stimuli or subcortical neurons. Regardless of their loci, the speech and vegetative neural commands are conceived as parallel inputs. If issued simultaneously there is a competition at some level of the neuraxis for the 'final' effector neurons. During speech activity the vegetative command neurons might be inhibited. Netsell believes that practice in vegetative movements serves only the vegetative synapses that must be inhibited during speech production. In speaking, speech motor control is acquired through other aspects such as imitation of acoustic patterns, provided by the adult model of the language. The vegetative sensorimotor routines are not the building blocks or neuromotor foundations from which speech development emerges, differentiates or refines.

Kent (1981) agrees that a basic question about the early stage of speech development is whether changes in the oral reflexes precede and prepare the

way for various motor development in speech. He believes that normal development of speech motor control is based on reflexes organized into functional units. There is abundant evidence of extensive reflex interactions in the respiratory, laryngeal, oral and perioral regions (Netsell and Abbs, 1975). Kent states that stimulation of oral receptor sites can alter the input to the motoneuron pools that activate brainstem structures and that the activity of oral and perioral reflex pathways can be modulated.

ABNORMAL MOUTH BEHAVIOUR

Just as the study of normal development of mouth functions can give more insight into abnormal developmental patterns, the reverse is also true. Studying orally handicapped children as cleft lip and palate babies or cerebral palsied children with mouth function problems, we notice in the first group the effects of an abnormal mouth structure on speech development and in the second the influence of the abnormal neuromuscular system and abnormal oral sensibility on speech sound production. Speech pathologists educated in neurodevelopmental treatment are therefore pleading for a so called 'pre-speech therapy' (Müller, 1968, 1972). They try to control the oral sensibility in a behavioural way by desensitizing the child for several tactile stimuli and diminishing excessive drooling. They try to stabilize the total body position and facial posture, to influence the oral muscle tonus to a more or less normal level. In this way they can evoke a smoother, better coordinated execution of mouth behaviours in sucking, swallowing, biting and chewing. It is their opinion that the orally handicapped child can habituate himself in due course to better executed basic skills in mouth functions. At that point in primary mouth function development, better conditions are created for speech developmental treatment by communicative interaction and other behavioural methods. Concerning the effects of these 'prespeech' therapies on speech motor development no scientific data are known. Netsell (1981) believes that as evidence for such treatment programs all classes of data (neurophysiological, neuroanatomic or behavioural) are important to consider.
McWilliams, Morris & Shelton (1984) discussing feeding problems in cleft lip and palate babies and their effect on speech sound development underline the need to look further into the behavioural aspects seen in the intimacy of the feeding situation of the mother and her cleft lip and palate child. They consider these early feeding experiences highly relevant for the early learning of speech, language and psychosocial interaction.

SPECIFICATION OF OUR RESEARCH PROBLEM

In order to get more insight into the feeding as well as mouth function development in relation to speech we decided to put special emphasis on this aspect in a larger research project, called: 'The Influence of the Orthopedic Oral Appliance on Speech Development and Interaction in Cleft Lip and Palate Children (0-2 years)' (Koopmans-Van Beinum, Van der Stelt &

Jansonius-Schultheiss, 1984). A feeding-questionnaire was drafted, meant for the parents of normal and cleft palate children, which should monthly be completed. In addition audio-visual recordings of mother-infant interaction during the feeding process were scheduled in order to examine oral sensori-motor aspects in the child and total communication patterns in the mother-child interaction. On top of that, we decided to examine the child orally in certain months to assess oral reflex patterns.
Questions we will try to answer are: is it possible to relate the normal developmental line concerning (some) aspects of primary mouth functions to (certain) milestones in speech sound development in the first year of life. As Van der Stelt & Koopmans-Van Beinum (1984) showed in their research concerning the development of speech motor behaviour in the first year of life in normal babies, a significant t-test result ($p < 0.05$) between thumb sucking and the onset op babbling was found; children, which were sucking their thumbs moderately reached the babbling milestone (reduplicated articulatory movements during one respiration cycle) earlier. Moderate thumbsucking can probably stimulate the oral sensori-motor development. Both researchers, which are interested in the early stages of speech sound development in relation to gross motor development, drafted an inquiry concerning certain behavioural aspects in infants (Van der Stelt and Koopmans-Van Beinum, 1985). Parents and other caretakers of children were asked about social, speech, gross motor and some mouth function aspects, such as the beginning of chewing, the first tooth and drooling, in an arbitrary week in the first year of life of their infant. The inquiry is still in progress and we expect to receive more completed inquiry-booklets in the near future after which we can produce further statistical results. Based on the answers of 70 parents engaged in this inquiry Koopmans-Van Beinum and Van der Stelt (1985) could clearly delineate their speech motor milestones in the speech development in the first year of life. This was very satisfying: parents seemed to be important and reliable informants. Talking about the normal developmental lines in mouth behaviour and their possible relations to speech sound production we cannot ignore the study concerning these aspects in orally handicapped children such as the cleft lip and palate babies and their mothers. We are wondering if an atypical development in the feeding process can have impact on the speech developmental milestones as indicated in the work of Koopmans-Van Beinum and Van der Stelt (1979, 1981, 1985). In the literature concerning feeding problems in cleft lip and palate children (McWilliams, Morris & Shelton, 1984) a relation is conjectured. As described by Hovenier (1985) and as said by speech pathologists there are indications about the negative effects a disturbed feeding process has on vegetative mouth behaviour and speech motor development especially in orally handicapped children. In that case we hope to correlate biological (nature) aspects as well as interactional (nurture) aspects in the feeding process with specific speech sound developmental data.

REFERENCES

Bullowa, M. (ed.) (1979), Before Speech. The Beginning of Interpersonal Communication, Cambridge University Press, Cambridge.

Hovenier, E. (1985), Mondgedrag en Voeding bij Kinderen met Schizis, scriptie Opleiding Logopedie, Utrecht.

Kent, R.D. (1981), Articulatory-Acoustic Perspectives on Speech Development, in: Stark, R.E. (ed.), Language Behavior in: Infancy and Early Childhood, Elsevier/North-Holland, New York.

Jansonius-Schultheiss, K., Van Coppenolle L. & Beyaert, E. (1985), Afwijkende Mondgewoonten. Inleiding in Onderzoek en Behandeling, Acco, Leuven.

Koopmans-Van Beinum, F.J. & Van der Stelt, J.M. (1979), Early Stages in Infant Speech Development, in: IFA-Proceedings 5, Amsterdam, 30-43.

Koopmans-Van Beinum, F.J. & Van der Stelt, J.M. (1981), Note on Motor Analysis of Infant Sound, in: IFA-Proceedings 6, Amsterdam, 23-45.

Koopmans-Van Beinum, F.J. & Van der Stelt, J.M. (1985), Early Stages in the Development of Speech Movements, in: Lindblom, B. (ed.), Precursors of Early Speech, Wenner-Gren Symp.-Series, MacMillan Press Ltd., Basingstroke.

Koopmans-Van Beinum, F.J., Van der Stelt, J.M. & Jansonius-Schultheiss, K. (1984), Speech Development and Interaction in the First Years of Life of Normal and Cleft Palate Babies, IFA-Proceedings 8, Amsterdam, 65-69.

McWilliam, B.J., Morris, H.L. & Shelton R.L. (1984), Cleft Palate Speech, Decker Inc. Philadelphia/ C.V. Mosby Comp. Saint Louis.

Müller, H.A. (1968), Feeding, in: Finnie, N.R., Handling the Young Cerebral Palsied Child at Home, Ch. 7, Heinemann, London.

Müller, H.A. (1972), Facilitating Feeding and Prespeech, in: Pearson, P.H. & Williams, C.E. (eds), Physical Therapy Services in the Developmental Disabilities, Ch. Thomas, Springfield, 283-309.

Netsell, R. & Abbs, J. (1978), Modulation of Perioral Reflex Sensitivity during Speech Movements, Journal of the Acoustic Society of America, Supplement 58:541

Netsell, R. (1981), The Acquisition of Speech Motor Control: A Perspective with Directions for Research, in: Stark, R.E. (ed.), Language Behavior in Infancy and Early Childhood, Elsevier/North-Holland, New York.

(1982), Speech Motor Control and Selected Neurologic Disorders, in: Grillner, S., Lindblom, B., Lubker, J. & Persson, A. (eds.), Speech Motor Control, Wenner-Gren Symp.-Series, Pergamon Press, Oxford.

Oller, D.K. (1981), The Emergence of the Sounds of Speech in Infancy, in: Yeni-Komshian, G., Ferguson, C.A. & Kavanagh, J. (eds.), Child Phonology:Vol. I:Production, Academic Press, New York.

Trevarthen, C. (1979), Communication and Cooperation in early infancy: a Description of Primary Intersubjectivity, in: Bullowa, M. (ed), Before Speech. The Beginning of Interpersonal Communication, Cambridge University Press, Cambridge.

Van der Stelt, J.M. & Koopmans-Van Beinum, F.J. (1985), The Onset of Babbling related to Gross Motor Development, in: Lindblom, B. (ed.), Precursors of Early Speech, Wenner-Gren Symp.-Series, MacMillan Press Ltd., Basingstoke.

The researchproject concerning 'The Influence of the Oral Appliance on Speech Development and Interaction in Cleft Lip and Palate Children (0-2 year)' is granted by the Netherlands Preventive Fund, The Hague, The Netherlands.