VERBAL INTERACTION BETWEEN MOTHER AND CHILD*

by J.M. van der Stelt

ABSTRACT

This paper reports on research on early communication systems of mother and child, which is done around the baby's age of six and a half months. Three recordings of ten mother-baby pairs are analyzed with regard to mother and baby performances, supposing the mother would react in a specific manner upon phonetic milestones in the baby's sounds. We found indications that mother and baby have developed a conversation style within the first eight months of their co-existence.

OVERVIEW OF RELATED PREVIOUS WORK

In literature we found that very little was known about the articulatory development in the first year of life. Articles had appeared about the order of phoneme acquisition, but such studies concerned older children. Furthermore we considered recognition of speech sounds in sounds of a baby a quality of the listener with an unknown relation to sound production itself. We decided to do a study on development of sound production from birth onward. From two normal, healthy babies we recorded non-crying sounds weekly. Those sounds were not transcribed by means of an alphabetic system, but we developed a transcription method noting respiratory, phonatory and articulatory movements. In our view speech development aims at complex coordination of the movements

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mentioned above in relation to specific semantic contents. Results from this study indicate that the development of the coordination is a systematic one. In the development we indicated three phonetically important milestones. Our definition of babbling in this system is the ability of a baby to produce (repeated) articulatory movements with (interrupted) phonation in one single expiration. In interaction with the parents the babbling milestone is an important one since parents recognize the sounds as speech sounds. Many first 'words' of babies are characterized by repeated articulatory movements: the parents attribute a semantic content: 'bapapa' or 'dada', 'mammam', etc.
We were interested in a mean age of onset of babbling as well. This proved to be about six and a half months, in a sample of 50 children. We suppose that recognition of speech sounds in the variety of sounds produced by a babbling baby provokes the mother to respond mainly verbally. Hearing babies are stimulated systematically in a visual and auditory manner. In literature children born deaf show a considerable decrease in sound production at that age, but deaf babies must do with visual, therefore limited information.
We decided to investigate the mother's behaviour around the onset of babbling of her baby.

INTRODUCTION

This paper reports on research on early communication systems of mother and child. The systems are supposed to develop during interaction between mother and child: sound production of both of them shows a growing tendency to systematize.
The very first episode of speech development shows a lack of knowledge about sound interaction. The sounds babies produce are often characterized by means of terms used when describing adults' sounds. A private baby system of sound production may thus be hidden. A baby produces quite a lot of sounds. Recognition of speech sounds by adults then reveals more about the aptitude of

the adults' ear than about ways of sound production in the baby. In adult sound production a sound-meaning relation can be described in alphabetic terms. However, adults became conditioned to the sound products of movements in the speech apparatus. Communication is often considered to be transfer of meaning. In young babies perhaps only transfer of movements is related to 'meaning' in a broad, supramodal sense.

Some years ago we developed a transcription method to describe sounds produced by very young babies. The successive non-crying sounds of a baby are not described by means of a system related to the alphabet. Baby sounds are analysed in relation to respiratory, phonatory and articulatory movements. At the age of about six and a half months two male babies (of which we recorded sounds from birth onwards to about eight months of life) were able to coordinate in complex ways respiratory, phonatory and articulatory movements.

Secundary functions of respiration, larynx and mouth begin to be developed. The babies then produce sounds as 'papapa' or 'mamamm' during one single expiration: we defined this ability in sound production as babbling. Physiologically an adult pronouncing a sentence does not differ very much from a babbling baby. Coordination of respiration, voice and articulation, even within one speech system, is not very rigid. The individual is permitted some liberties in movements and coordination and will still be understandable. The babbling milestone, which is phonetically important in speech motor development, is preceded by two other milestones. The first one is reached at the age of about six to nine weeks when phonation can be varied during one single expiration, resulting in sounds like 'u-u-u' or 'ahu'. When about twelve to fourteen weeks old a baby can coordinate respiratory and phonatory movements as well as one single articulatory movement in one single expiration. Products of these movements sound like 'arre' or 'achu' or 'umm'.

I	varying phonation in one expiration /ù-ù-ù; hù-hù; aha; uhu/,	6 - 9 weeks
II	phonation and one articulatory movement in one expiration /arru; achu; umm/	12 - 14 weeks
III	phonation and repeated articulatory movements in one expiration: babbling /apaba; ummumm/	27 weeks and older.

Table 1: Milestones in speech motor development (0-8 months)

The babbling milestones has been subject to further research in order to normalize for age. We contacted parents of some fifty normal and healthy babies that were about three to four months old. The parents were to report the day they recognized babbling for the first time. They consented as well to cooperate in a study on the development of sound production in very young babies. We thus hoped to record mother-child sound interaction in a rather natural setting. In that study the mother was asked to elicit sounds from her baby. Students taperecorded mother-baby interaction on three occasions. This resulted in 31 recordings when the baby was about four months old, 19 recordings (from these 31 pairs) when the baby had just started babbling and 11 recordings (from the previous 19 pairs) of sound interaction about one month after the first occurrence of babbling.
The study of sound interaction was done in the period around the first occurrence of babbling since adults easily recognize these sounds produced by the baby. The child produces his first 'words', so the mother might differentiate her conversational behaviour. Furthermore the baby seems to be ready to enjoy sound interaction for babies born deaf show a dramatic decrease in sound production at the age of about six months. We speculate that deaf babies are not able to transfer from 'playing with the mouth' (mainly tactile-kinesthetic) to 'playing with sounds' (mainly auditory).

METHOD OF QUANTITATIVE ANALYSIS

We supposed that mothers would differ in their reactions to the successive milestones, so we attributed the baby sounds to the following categories: milestone 1, 2 and 3, laughing, crying, vegetative sounds and no audible reaction on mother's sounds (7 categories).

scoring number	description	example
0	vegetative sounds	hiccup, belch
1	milestone 1	ù-ù, ahu
2	milestone 2	arre, umm
3	milestone 3	ebawawa
4	crying	bèèèè
5	laughing	hahaha
6	no-reaction	?

Table 2: Categories of baby's sound production

As to the sound production of the mothers the 61 tapes were typed out completely. Length of the segments ('sentences') depended either on the moments the mother was heard to inspire or on a considerable pause. Categories important to start and maintain a (proto-) conversation are used to analyze the utterances of the mothers. Probably the mother influences the conversation by means of eliciting or reacting behaviour. These categories differ mainly in sentence melody, which adults tend to exaggerate. Apart from eliciting and reacting behaviour of the mother we differentiated in 'conversation with others than the baby', 'laughing', 'verbal games', 'mother expressing her own feelings or thoughts', 'mother verbalising her baby', 'mother eliciting motor activities of the baby' such as crawling, turning, etc.

scoring number	description	example
0	motor activities	'go and stand up',
1	verbalising the baby	'mmm, that's nice,'
2	reaction to sounds	'oh yes, certainly!'
3	eliciting sounds	'are you going to talk?'
4	verbal games	'little mouse,'
5	laughing	'hahaha',
6	mother's own	'I'll stop the recorder!'
7	conversation with others	'Yesterday he talked!'

Table 3: Categories of mother's sound production

Using the above mentioned categories (Tab. 2 and Tab. 3) the 61 tapes were coded, the starting point being the first utterance of the mother, thus alternating codes for mother and child.
Analysis of a tape on which a mother talks continuously (giving no turn to the baby?) results in many no-reaction codes for the baby. In the monologue of the mother the baby does not react to utterances of his mother. In the dialogue, with turn-taking aspects, the mother succesfully elicits milestones in the sound production from the baby.
The monologue of the baby (mother does not react) is analysed in a more simple way. Whenever a milestone occurred that code prevailed over all others. When a choice of milestone codes was possible the highest ranking was chosen. So, a monologue of the baby was attributed just one code, often a milestone one, due to the method of analysis. With regard to the other categories of baby's sound production milestones and no-reaction behaviour were accentuated. In view of the question as to how mothers start and maintain a conversation with their babies this coding seems adequate, since we were more interested in the mother's behaviour than in the child's. Continuous interaction is segmented and each segment consists of two behavioural codes: first the mother, then the baby. Matrices

and subsequently frequencies represent a one way look at the data. No conclusions are possible about the mother's behaviour with regard to previous sound production of the baby.
This data analysis however gives some quantitative indications:

- about 75% of the total sound production of the mothers is within the categories 'eliciting' or 'reacting'. As the baby grows older the mother shows relatively more 'reacting' behaviour.
- no-reacting of the baby diminishes in the successive recordings, milestone behaviour increases.
- there is no clear change in the mother's behaviour with regard to the third milestone in the overall analysis of the second and third recordings. (See Appendix I for the matrices).

METHOD OF QUALITATIVE ANALYSIS

After interpretation of the quantitative analysis of all data we decided to have a closer look at the data since no difference was made between monologue, dialogue or any other situation. In view of the amount of work in detecting monologues and dialogues we decided to analyse the recordings of those ten mother-baby pairs of which we had tapes on all three occasions. Furthermore the recordings had to be of a considerable duration. From the ten pairs four were eliminated on basis of the following criterion: one of the three recordings of those four pairs was having less than a quarter of the mean number of interactions for all ten pairs in the corresponding recording. One mother for example only spoke eight times in a session to her baby.
For the six pairs left we have been looking for specific interaction patterns of eliciting and reacting in monologue and dialogue situations. We did not differentiate the dialogue situation with regard to the three milestones, since overall percentages showed relatively small amounts of milestone 3 behaviour.
The turn-taking aspect which we considered an important issue is analysed in the following manner. For all three recordings of a

pair we traced series of milestone codes in the baby's sound production. A series is defined as consisting of at least two successive milestone codes with a mother's code in between. Such a series shows more conversational, interactive aspects than a casual milestone.

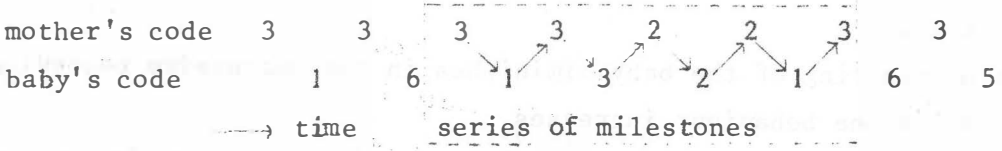

Table4: Example of a dialogue.

RESULTS

Dialogues

Per pair and per recording the number of dialogues was counted. A tape had for example 200 codes for the mother and thus 200 for the baby. On that tape the baby might have produced 20 series of at least two successive milestones: the number of dialogues then was 20.
A mean length of dialogues was calculated, indicating a kind of turn-taking ability of the pairs, or possibly reflects a growing competence of the baby which the mother might or might not react to. Roughly two groups of three pairs were found. In one group the mean lenght of dialogues increased gradually over three recordings. In the other group the mean lenght varied.

(See Tab. 5.)

pair number	sex child	babbling age in days	Recording 1			Recording 2			Recording 3		
			number of interact.	number of series	mean length of series	number of interact.	number of series	mean length of series	number of interact.	number of series	mean length of series
14	m	180	218	23	4.3	75	8	2.7	79	8	5.7
31	m	176	117	13	3.0	85	13	3.5	37	5	4.9
35	v	181	76	2	2.0	20	3	4.0	42	3	5.0
44	v	251	133	11	3.3	184	10	2.7	222	16	3.0
47	v	262	135	3	2.9	50	2	5.5	54	7	2.5
48	m	221	146	14	2.7	156	12	3.3	85	7	3.9

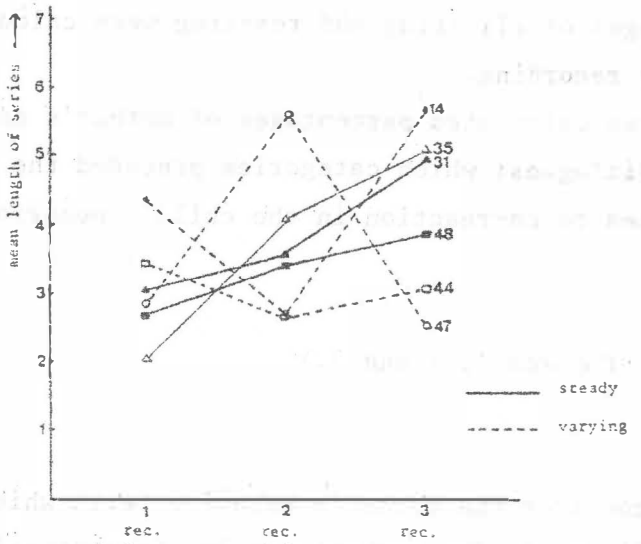

Table 5. Mean length of series of milestones per recording for six pairs.

Next we had a closer look at the mother's codes in the dialogues. The codes of mother's sound production preceding the series of milestones of the baby were divided in three groups: eliciting, reacting and a residual group (not represented in the diagrams).

If 10 out of 20 dialogues started with eliciting behaviour this was indicated in the figures as 50%. A 40% score was indicated when 8 out of the 10 dialogues left started with reacting. So eliciting, reacting and the residual group together formed 100%: the residual group's percentage could thus be calculated from the figures. Apart from the behaviour preceding a series of milestones the mother's behaviour immediatly after the first milestone in a series was analysed as well since we were curious to know in what way the mother tried to 'keep the conversation going'. Again percentages of eliciting and reacting were calculated for each pair per recording.
Finally we calculated percentages of mother's codes at the end of the dialogues: which categories preceded the switch from milestones to no-reaction in the child's behaviour.

(See the figures 1, 2 and 3.)

We now consider the mother's behaviour with which the dialogues start. (figure 1. The percentages in the successive recordings were interconnected in a line but nothing may be concluded about behaviour in the periods between the recordings).
Almost all mothers mainly elicited the baby to sound production. There remained some reacting and residual behaviour as well. This was to be expected, although eliciting behaviour in the successive recordings did not show a clear pattern for all pairs.
Once the baby showed milestone behaviour (figure 2) the mothers changed their behaviour too. In pairs number 14 and 47 the mothers continued to show eliciting, reacting and residual behaviour. The mother in pair number 44 persisted in eliciting her baby. As to the mothers in pairs 31, 35 and 48, they hardly showed any eliciting behaviour (with the exception of number 35 in the third recording). They were mainly reacting upon the milestone behaviour of the baby.

eliciting

reacting

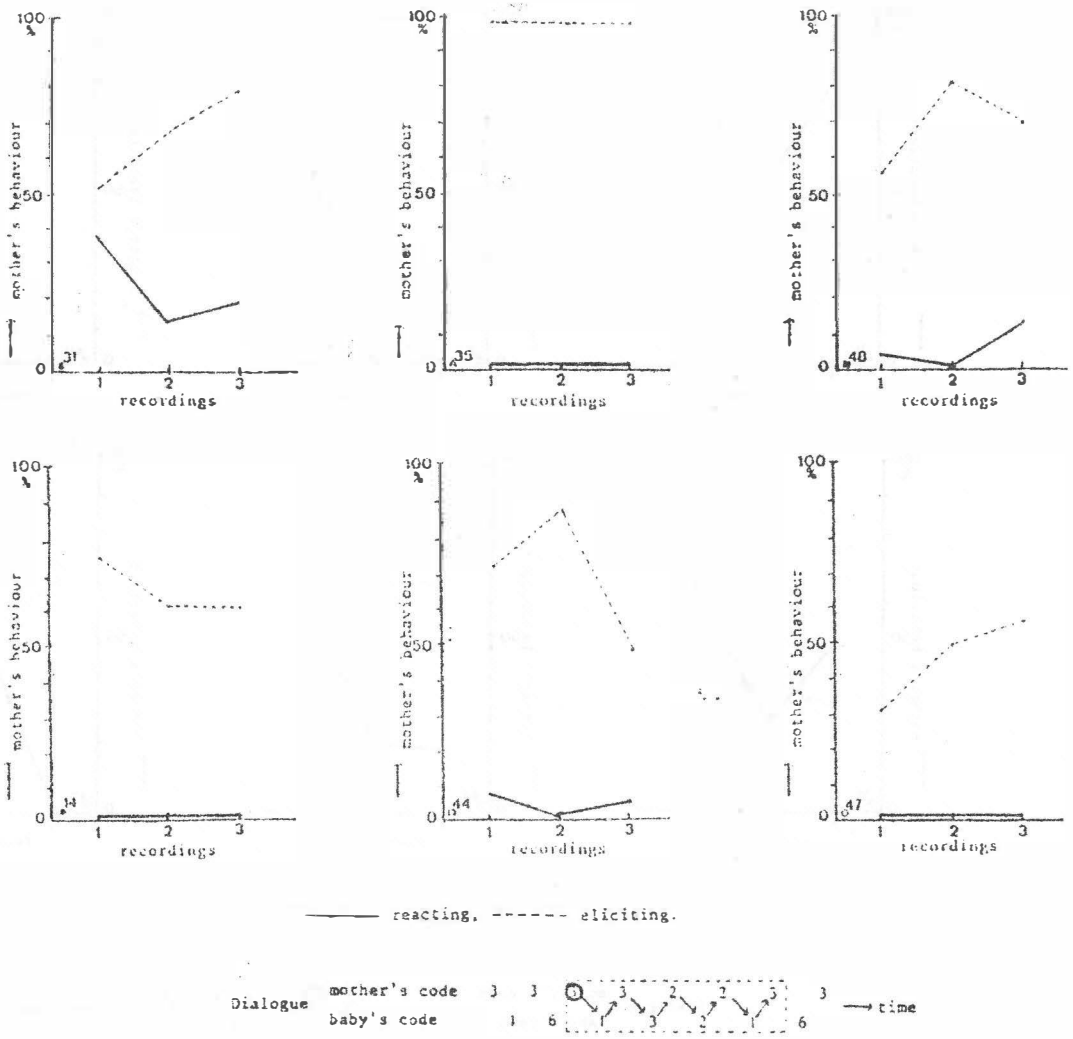

Figure 1. Percentages of mother's behaviour at the start of a dialogue with her baby in three successive recordings. Mother and baby are taking turns in a proto-conversation: the baby produces at least twice a milestone (1,2 or 3) in succession with a mother's code in between.

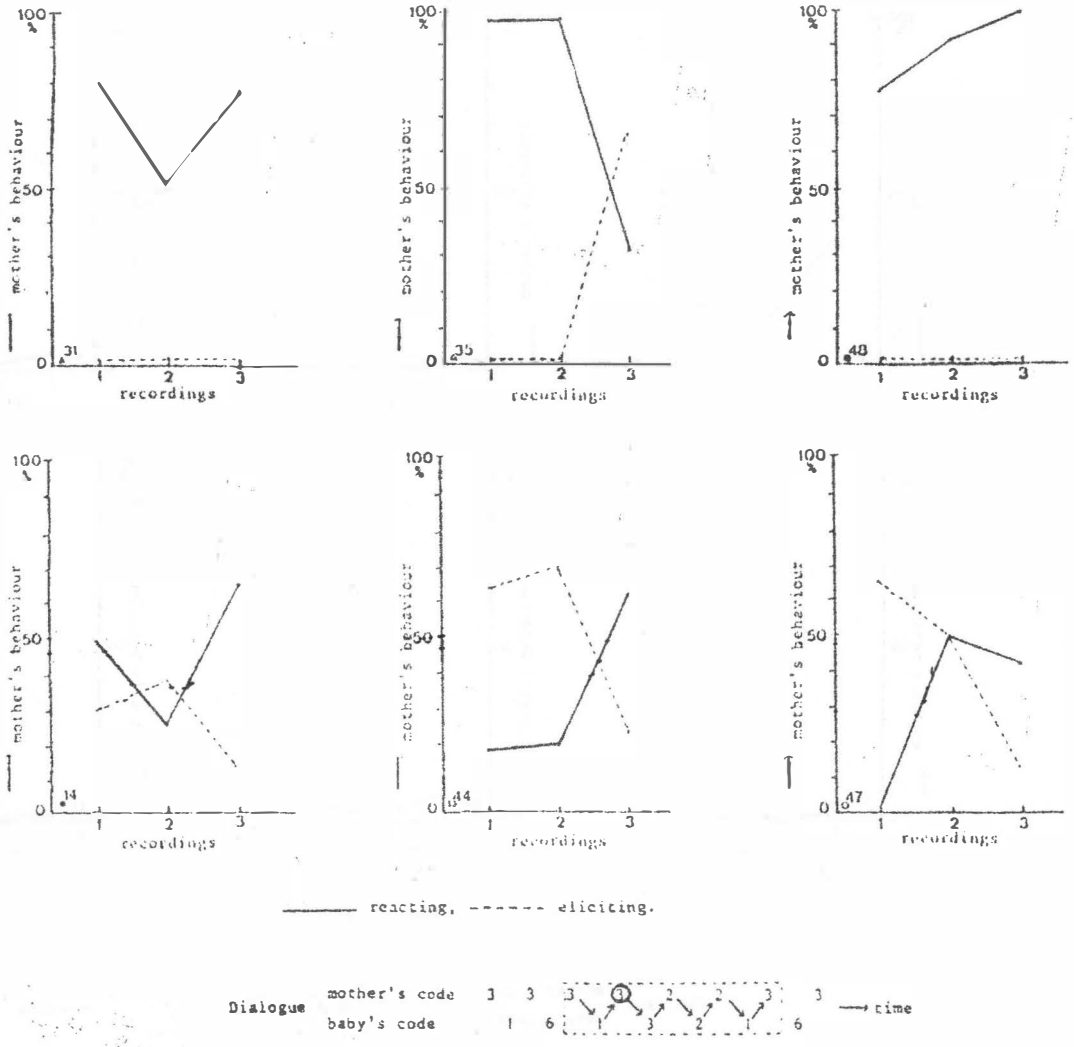

Figure 2. Percentages of mother's behaviour in a dialogue, immediatly after the first milestone of her baby. Percentages of eliciting and reacting of the mothers are calculated per pair and per recording.

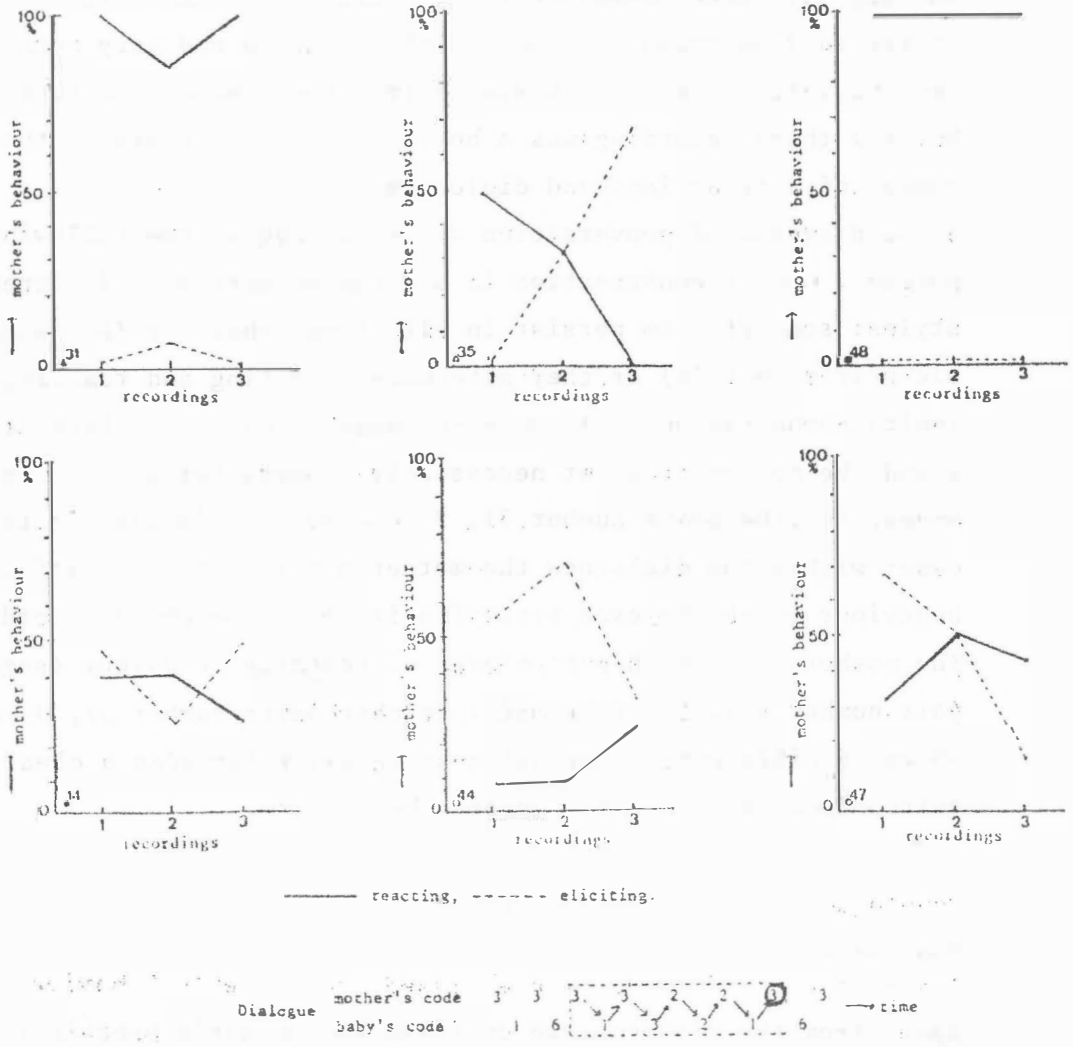

Figure 3. Percentages of mother's behaviour at the end of a dialogue in three successive recordings. These mother's categories precede the baby's switch from milestones to no-reaction.

When we consider figure 3, representing final mother behaviour in the conversations we see patterns as in diagram 2: 14 and 47 showing all three behavioural categories, 44 mainly eliciting or residual behaviour, 31 and 48 no eliciting and very much reacting. Pair number 35 deviates from the previous pattern, but the third recording was a border case with regard to the number of interactions and dialogues.
These diagrams of conversation analysis suggest the following points . Once a conversation is started mothers show different styles: some of them persist in eliciting behaviour (for example pair number 44) or they alternate eliciting and reacting (pairs number 14 and 47). When the baby produces a milestone sound the mother does not necessarily changes her kind of utterances. For the pairs number 31, 35 and 48 this is clearly the case: within the dialogues the mother rarely shows eliciting behaviour (with the exception of pair 35 in the third recording). The mothers show high percentages of reacting behaviour (see f.e. pair number 48). We might conclude that pairs number 31, 35 and 48 use a different conversation style which includes a clear switch from eliciting to reacting behaviour.

Monologues

Apart from the dialogues we analysed the mother's behaviour in a similar way when the baby did not react: the mother's monologues.

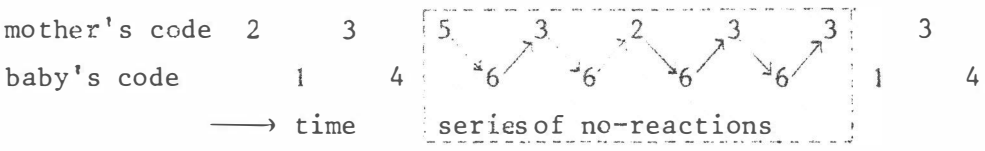

Table 6: Example of a monologue.

Again we counted per pair per recording the number of monologues

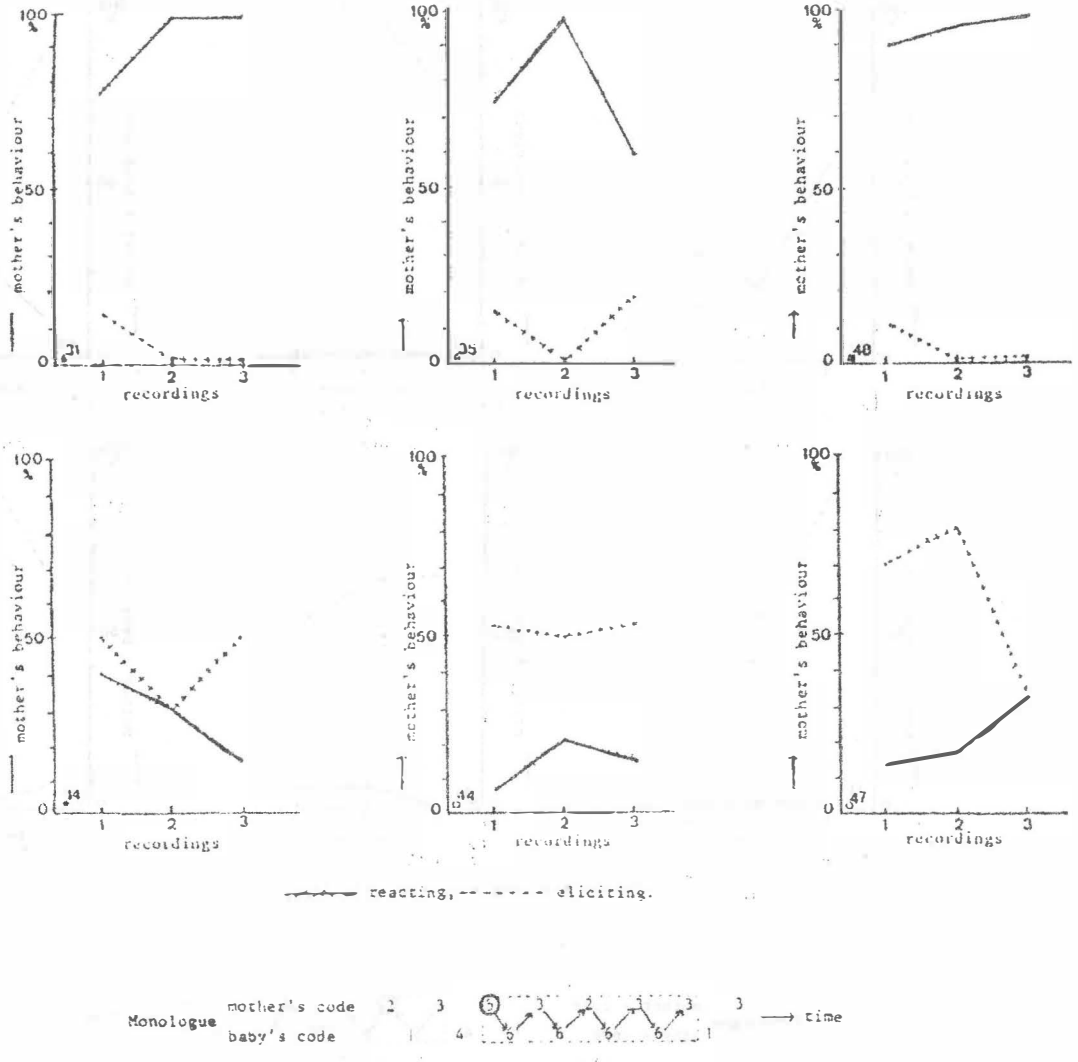

Figure 4. Percentages of mother's behaviour at the start of a monologue: the baby does not react in at least two successive turns. Percentages of eliciting and reacting are calculated per pair and per recording.

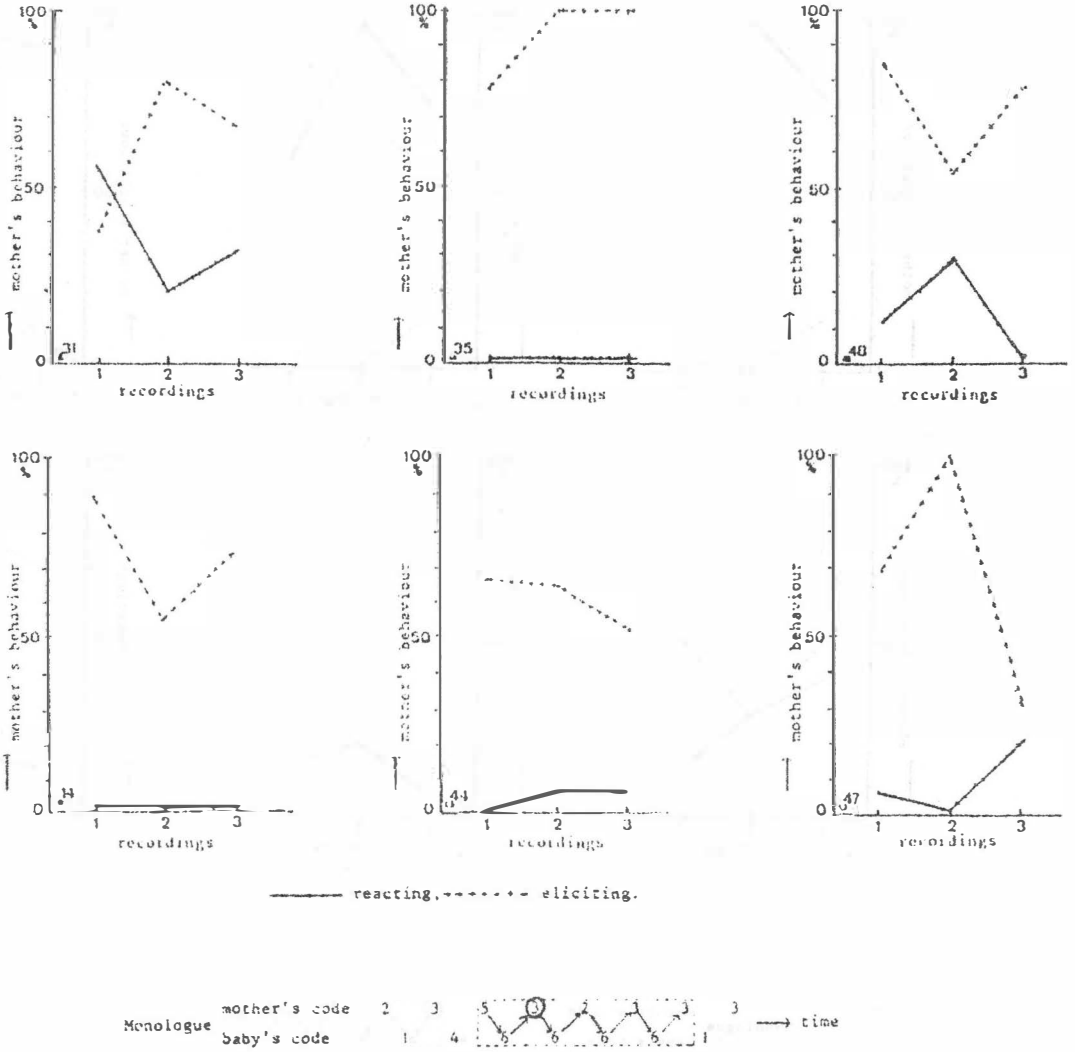

Figure 5. Percentages of mother's behaviour, immediatly after the first 'no-reaction'-turn of the baby: a mother's monologue. Percentages of eliciting and reacting are calculated per pair and per recording.

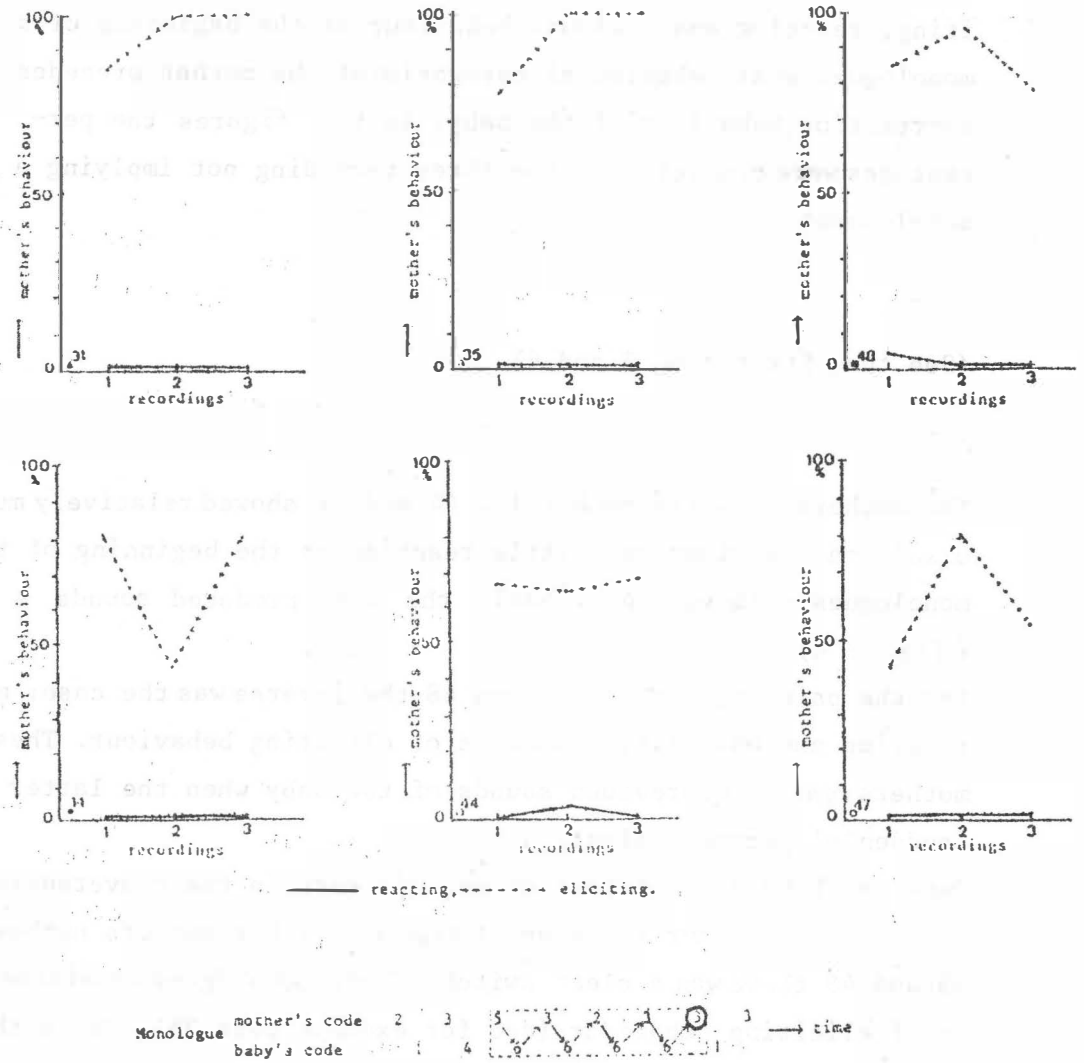

Figure 6. Percentages of mother's behaviour at the end of a monologue: the baby switches from no-reaction (code 6) to milestones (code 1,2 or 3).

(the baby showed no-reaction at least twice in succession). Similarly to the dialogues we calculated percentages of eliciting, reacting and residual behaviour at the beginning of a monologue: what behavioural categories of the mother precedes no-reaction behaviour of the baby. In the figures the percentages were connected in the three recording not implying a development.

(See the figures 4, 5 and 6)

The mothers of pairs number 14, 44 and 47 showed relatively much eliciting behaviour and little reacting at the beginning of the monologues although previously the baby produced sounds (figure 4).
For the pairs number 31, 35 and 48 the inverse was the case: much reacting and only little amounts of eliciting behaviour. These mothers reacted to previous sounds of the baby when the latter 'suddenly' became silent.
Once the baby did not take or get his turn in the conversation eliciting behaviour increased (figure 5). For mothers number 31, 35 and 48 there was a clear switch. Their monologues consisted mainly of eliciting behaviour (see for example pair 35). The mothers number 14, 44 and 47 increased in eliciting behaviour but there was no clear switch from reacting to eliciting. These patterns did not change considerably at the end of the monologues (figure 6), but the mothers number 31, 35 and 48 still showed an increasing percentage of eliciting behaviour, whereas the mothers number 14, 44 and 47 showed more residual behaviour.

Dialogues and monologues together

Taking together the analysis of dialogue and monologues the pairs number 31, 35 and 48 clearly show different behaviour in the two

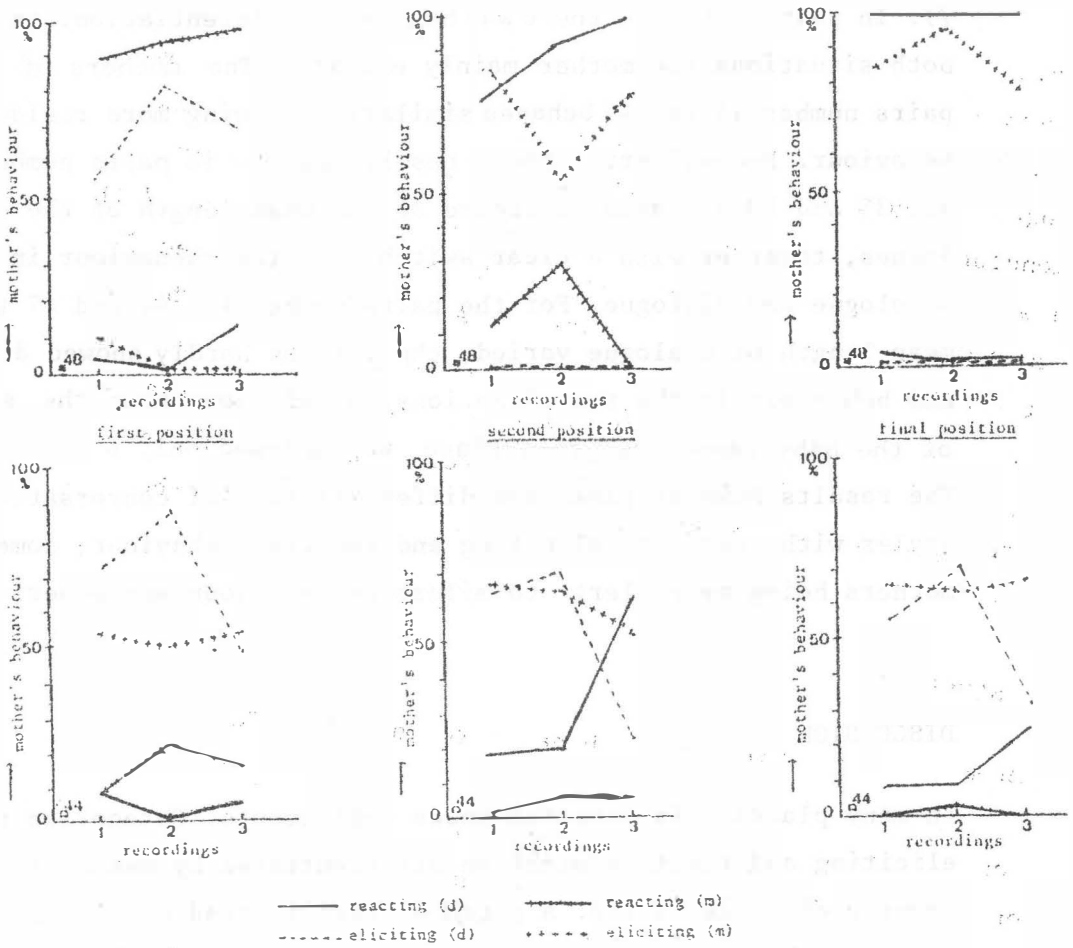

Figure 7. Comparison of mother's behaviour in dialogues and monologues for two pairs (44 and 48) in three successive recordings. From left to right: - mother's behaviour at the start of a dialogue or a monologue (first position, see fig. 1 and 4), - mother's behaviour immediatly after the first turn of the baby in a dialogue or a monologue (second position, see fig. 2 and 5), - mother's behaviour at the end of a dialogue or a monologue (final position, see fig. 3 and 6).

situations: a switch from reacting to eliciting of the mother as soon as the baby was silent, see for example pair 48 (figure 7). In pair number 44 there was hardly a differentiation: in both situations the mother mainly elicits. The mothers of pairs number 14 and 47 behaved similarly, showing more residual behaviour. Reconsidering these results we saw in pairs number 31, 35 and 48 a gradual increase of the mean length of the dialogues, together with a clear switch in mother-behaviour in monologue and dialogue. For the pairs number 14, 44 and 47 the mean length of dialogue varied, the mothers hardly showed different behaviour in the two situations. A relation with the sex of the baby cannot be given since we analysed only 6 pairs. The results however plead for differentiation of conversation styles with regard to eliciting and reacting behaviour, some mothers being very alert to milestone behaviour and others not.

DISCUSSION

In many places this research needs refinements. Categories as eliciting and reacting might be differentiated by means of acoustic criteria as f.e. a pitch pattern instead of perceptive ones. Furthermore it is possible that all mothers will show a switch in behaviour when confronted with milestone 3 in the baby. In this study we had not enough observations in this category. Categorisation of the baby's sound production may be simplified with the aid of physiological data as respiration cycle for example. We observed direct interaction but partners in conversation may show delayed reactions. Visual and tactile aspects of interaction are completely neglected (video?).
For some pairs patterns in phonation may be important, for others probably articulatory aspects. In our view the study of interaction can reveal elements and patterns that are active in the development of speech communication. The way partners develop their particular communication system may reveal specific elements that cannot be found by studying the partner's sound production by itself.

Appendix I

Recording 1: n = 31

c ↓ m →	0	1	2	3	4	5	6	7	total
0	0	0	0.4	0.6	0	0.0	0	0.1	1.2
1	2.6	1.1	8.9	13.2	1.0	0.5	0.3	1.4	29.1
2	0.7	0.1	2.8	2.8	0.1	0.0	0.0	0.3	7.1
3	0.3	0.0	0.3	0.0	0	0.0	0	0.0	0.9
4	0.3	0.1	1.0	0.7	0	0	0	0.3	2.4
5	0.1	0	0.3	0.3	0.3	0.2	0	0.0	1.3
6	2.7	2.7	8.1	36.8	1.8	1.0	0.7	3.8	58.0
total	6.9	4.2	21.9	54.7	3.1	1.9	1.0	6.0	100% (2826)

Recording 2: n = 19

c ↓ m →	0	1	2	3	4	5	6	7	total
0	0	0.1	0.5	0.4	0.0	0	0.0	0.3	1.5
1	1.1	1.1	7.5	13.1	0.8	0.5	0.4	2.5	27.0
2	0.6	0.3	2.5	2.3	0.0	0.2	0.2	0.6	6.7
3	0.1	0.0	0.8	0.9	0	0.1	0	0.2	2.3
4	0.2	0.0	0.6	0.9	0.1	0.0	0.0	0	2.0
5	0.0	0	0	0.1	0.0	0	0	0.0	0.3
6	3.7	2.8	9.2	34.2	1.1	1.2	1.7	6.3	60.3
total	5.7	4.5	21.6	52.0	2.1	2.1	2.4	10.0	100% (1772)

Recording 3: n = 11

c ↓ m →	0	1	2	3	4	5	6	7	total
0	0	0	0.4	0.3	0	0	0	0	0.7
1	1.3	1.2	11.3	11.3	1.7	0.5	0.3	0.7	28.4
2	0.4	0.1	3.7	4.0	0.7	0.3	0.3	0.5	10.3
3	0.7	0.3	1.0	0.9	0	0.1	0	0	3.9
4	0	0	0.5	0.3	0	0	0	0	0.9
5	0	0.3	0.3	0.1	1.3	1.3	0	0	3.3
6	4.5	3.9	9.7	28.7	2.6	1.2	0.7	2.0	53.3
total	6.9	5.8	27.1	45.6	6.4	3.5	1.3	3.3	100% (690)

Matrices in percentages of mother-child sound interaction on three occasions; n gives the number of pairs per recording, 7 child categories, 8 mother categories. In brackets total number of interactions per recording.