

Mother-Fetus Communicative Relationship: A Longitudinal Study on 58 Primiparae and their Children during the First Eighteen Months

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Abstract: None available.

Full Text: Headnote ABSTRACT: The purpose of this longitudinal observational survey was to compare a questionnaire on fetal auditive exposure, administered to 58 pregnant women, to the Mac Arthur questionnaire recording the communicative and linguistic development of their children when ten- and eighteen-months-old. By 'fetal auditive exposure' we mean the natural exposure to the acoustic stimuli that the fetuses experience through their mother's living environment. Fifty-eight women in their sixth to ninth month of pregnancy were given a questionnaire evaluating the characteristics of the acoustic aspects of the mother's daily life environment and the quality and quantity of the mother's linguistic communication. Subsequently, the children were tested with the Italian version of the Mac Arthur questionnaire. Lastly, the two questionnaires were compared in order to examine possible associations between the child communicative and linguistic development and the fetal auditive exposure. In our sample we found that intentional linguistic communication from mother to the fetus is a relevant factor that can be associated to the communicative development of the children. The frequency of intentional daily mother-fetus linguistic communication shows an association with the linguistic understanding and the communicative actions and gestures of 18-month children. KEY WORDS: prenatal development, auditive exposure, linguistic development, mother-fetus communication.

INTRODUCTION Our study on the acoustic experience of the fetus comes from a broader interest: how the psyche develops in the interpersonal relationship between the fetus and its mother. The sensory experience of the fetus in the maternal womb represents an aspect of great interest. Several studies have shown how the newborn's competences follow a complex intrauterine development (Verny, 1989; Piontelli, 1992; Chamberlain, 1994; Righetti, 1996; Delia Vedova & Imbasciati, 1998; Kisilevsky & Low, 1998). These studies show how the fetus, from the 25th week onward, lives a multiform sensorial experience in relationship to the maternal body and the external stimuli. This experience concerns a possibility to perceive through all the sensory modalities and to preserve memory. In particular among the stimuli, the fetus is able to perceive sonorous stimuli. The sonorous experience of the fetus has been studied for a long time showing the existence of a complex ability of recognition of sounds and language besides the maternal voice. Literature underlines that from the 23rd week onward the fetus reacts to sounds, shows habituation to a repeated acoustic stimulus and can discriminate sounds (Madison, Adubato, Madison, Nelson, Anderson, Erickson, Kuss & Goodlin, 1986; Shaidullah & Hepper, 1994). Therefore the fetus is soon able to perceive and distinguish both the internal maternal body sounds and the external acoustic stimuli. In the uterine environment the fetus lives a vast sonorous experience among which are the maternal heartbeat, the breathing noises and the borborygmi. The womb is also permeable to external acoustic stimuli. Uterine attenuation of the sound is 20 to 70 dBs. Low frequency sounds are little attenuated (lower than 250 hzes) while the attenuation increases with higher frequency sounds (Lecanuet, Granier-Defere & Busnel, 1989; Birnholz & Benacerraf, 1983; Pujol, Lavigne-Rebillard & Uziel, 1990) consequently the voices and the external conversations are almost always distinguished. A systematic administration of acoustic stimuli in the last two months of pregnancy shows how the fetus recognizes other stimuli besides its mother's voice (De Casper & Fifer, 1980). Furthermore children who underwent prenatal educational programs showed elevated somato-sensory coordination and better communicative and cognitive development as seen in a few longitudinal studies (Van de Carr & Lahrer, 1986, 1988; Manrique, 1998; Lafuente, Grifol, Segarra, Soriano, Gorba & Montesinos, 1998). Through its perceptive abilities the fetus comes in contact with its mother and with

the environment, which is not only sensorial but also affective and interactional. We were interested in the relationship between fetal perceptive experiences and subsequent cognitive development, therefore we have decided to explore the auditive experience of the fetus and to investigate the hypothetical relationship between the type of fetal auditive exposure and communicative and linguistic development at ten and eighteen months.

THE RESEARCH This is a longitudinal observational study. The first phase has been developed on a sample of pregnant women and the following phases on their children during their first eighteen months of life. A wide sample of pregnant women (from sixth to ninth month of pregnancy) has been administered a questionnaire built to survey the sonorous characteristics of the maternal environment (Manfredi, Tomasoni & Imbasciati, 1999). This questionnaire was proposed by the midwives of the courses of childbirth preparation in Brescia and its outskirts. The pregnant women agreed to fill in the questionnaire on the auditive exposure in the presence of a psychologist. Afterward they were asked to be available for following phases of observation of the child once born. With those who agreed the psychologists observed the child at home at ten and eighteen months old. They gave the parents a questionnaire on the communicative and linguistic development (Mac Arthur questionnaire, Caselli & Casadio, 1995) and they asked the parents to fill in the questionnaire after having observed the communicative behavior of the child for a few days; clearly explaining that it was necessary to do it within a week before or after the child 10th and 18th month of life. The questionnaires were posted back to us.

The Sample The initial sample of 211 pregnant women who filled in the questionnaire on the auditive fetal exposure, came down to 58 mother-child couples at the end of our research. The pregnant women of our sample were all in their first pregnancy. Risky and premature labour cases have been excluded. The women of our sample were 20 to 40 years old, with an average age of 29. Nearly half of them (54%) graduated, 25% attended secondary school only and 21% got a degree. They all lived in Brescia, or in its outskirts, and were all married. Nearly half of them (49%) worked in an office, 20% were workers, 20% were professionals and 11% were housewives. The 58 children of our sample were 26 males and 32 females. All the children were healthy and naturally born.

Materials and Procedures The characteristics of the fetal exposure to the sonorous stimuli have been drawn by a questionnaire on the auditive exposure administered to the pregnant women (Manfredi, Tomasoni & Imbasciati, 1999) while the indexes of the communicative and linguistic development of the children have been drawn by the administration of Mac Arthur questionnaire ('The first vocabulary of a child: Gestures and Words, 8-18 months', Italian version, Caselli & Casadio, 1995) filled in by the parents when their children were 10 and 18 months old. The questionnaire on the fetal auditive exposure (see Manfredi, Tomasoni & Imbasciati, 1999) is composed by twenty-three multiplechoice questions. This tool investigated the auditive exposure distinguishing three aspects: the nature of the sonorous stimuli of the maternal environment (noise, music, radio, television, language), the quantity of exposure of the fetus to such stimuli (high, average, low), the source of such stimuli (maternal or environmental). The first part of the questionnaire examines the acoustic stimuli coming from the external environment while the second part investigates the maternal linguistic communication, particularly the maternal intentional linguistic communication with the fetus. The questions of this section survey: the frequency with which the mother talks to the child in uterus, the tone and the characteristics of the communication, when the communication takes place and whether it takes place in the presence of other people. The same questionnaire gathered personal information of the family. Mac Arthur questionnaire gathered information about understanding and production of the verbal non-verbal language in its first expressive forms. The questionnaire is divided into two parts: "The first vocabulary of a child" and "Actions and gestures". In the first part we have analyzed the section of a list of 408 words, divided into nineteen semantic categories, which we gathered into two new categories called nouns (sounds of nature, animals, vehicles, toys, food and drinks, clothes, parts of the body, furniture and rooms, familiar objects, open-air, people, routines), and grammar (verbs, adverbs, adjectives, pronouns, questions, prepositions, articles, quantifiers). In the second part we have analyzed the production of non-verbal forms of communication (actions, gestures, play, imitation, pretence) gathered in the category of actions and gestures.

Statistic Analysis The

statistic significances have been found through the analysis of the variance (ANOVA). In these analyses we compared the questionnaire on the auditive exposure of the fetus and Mac Arthur questionnaire and have treated as an independent variable the auditive exposure and as dependent variable the communicative and linguistic development of the 10 and 18-month children. Subgroups of children with a low, average or high auditive exposure have been compared in relationship to the variable investigated by the questionnaire on the auditive exposure (environmental noisiness, sonorous sources such as television, music, maternal language and communication pregnant-fetus). For the independent comparisons among the subgroups we have done post hoc tests. The communicative and linguistic development of the sample was quantified by the indicators of the development of the language drawn by the Mac Arthur questionnaire. The abilities of understanding and linguistic production have been quantified as number of words understood and number of words produced by children at ten and eighteen months. Therefore also the abilities of non linguistic communication have been quantified as number of actions and communicative gestures, forms of game, imitation and pretence produced by children at ten and eighteen months. The influence of children's sex and parent's profession and education have also been analyzed. RESULTS Through the questionnaire on the fetal sonorous environment we have gathered the variables, which identify the characteristics of the fetal acoustic exposure according to the quality of the acoustic stimuli and their intensity, stratified on three levels (low, average and high). We have analyzed the following acoustic variables: the generic environmental noise; some specific acoustic sources such as music, radio and television; and the mother's voice distinguishing the maternal communication with other people from the intentional communication to the fetus. As far as the communicative and linguistic development we have analyzed the following variables: the production and the understanding of the language and the production of actions and communicative gestures (Delia Vedova, Tomasoni, Manfredi, Pagliani, Mahony & Imbasciati, 2000). Our sample of 58 mothers showed a homogeneous distribution regarding the domestic environmental acoustic stimuli. The analysis has shown no significant association between the generic environmental noise variable and communicative and linguistic child development. The analysis of the variable related to the listening of television programs, which surveys how long the mother listens to the television daily, doesn't show any significant association with the linguistic aspects measured by Mac Arthur questionnaire. The analysis of the variable related to the hours of listening to radio programs doesn't show any significant association with the linguistic indexes measured by Mac Arthur questionnaire. Finally the analysis of the variable related to how much the mother listens to music every day doesn't show any significant associations with the linguistic and communicative variables. The analysis of the fetal exposure to the maternal speaking to other people (for example, how many times she speaks while working or during the day) shows no significant association with the variables measured by Mac Arthur. The only element of the fetal auditive exposure that underlines some statistically significant associations with the communicative and linguistic development of the children of our sample is the analysis of the variable measuring the presence of daily linguistic maternal communications to the fetus. In our sample 56 women out of 58 thought that the fetus could hear and 54 women out of 58 talked to their children in uterus during the day. This variable that we have defined as maternal intentional communication has been investigated according to different dimensions which measured the frequency, the tone and the characteristics of the communication to the fetus. For frequency we mean how many times in a day the mother talks to the fetus. Our sample developed three frequency subgroups. Subgroup 1 was composed of women who affirmed to talk to the fetus once a day (low exposure); subgroup 2 was composed of women who talked to it twice or thrice a day (average exposure); subgroup 3 was composed of women who talked to the fetus more than three times a day (high exposure). The analysis of this variable gives significant differences in some indexes of linguistic development in eighteen-month-old children, particularly for the understanding of the language and the production of actions and communicative gestures. We underwent all our analyses to the post-hoc test, which has underlined how the statistical significance of the differences was always from the subgroups of the average or high exposure towards the subgroup of low exposure. We have separately

analyzed the production and understanding of the non-grammatical terms of the language (see Table 1, nouns) and of the terms with a grammatical function (see Table 1, grammar). As in the Table 1, the average number of words understood by children whose mothers belong to the subgroups 2 and 3 is superior in comparison to subgroup 1, respectively for $p < 0.01$ for $p < 0.05$. The understanding of words with grammatical function underlines a similar result too. In fact children belonging to the subgroups 2 and 3 are shown to understand more words with grammatical function (grammar) than those of subgroup 1 ($p < 0.05$).

Table 1
Averages Related to the Understanding and the Linguistic Production in 18-month-old Children According to the Daily Frequency of the Maternal Intentional Communication

	<i>Daily Frequency of the Maternal Intentional Communication</i>					
	<i>Low</i>		<i>Average</i>		<i>High</i>	
	<i>Underst.</i>	<i>Product.</i>	<i>Underst.</i>	<i>Product.</i>	<i>Underst.</i>	<i>Product.</i>
Nouns	144.00	40.72	246.86**	79.24	238.85*	55.35
Grammar	44.45	5.00	76,44*	16.10	78,71*	10.00

* $< p 0.05$; ** $< p 0.01$; *** $< p 0.001$.

In these three groups no statistically significant difference is recorded in the production of the language as it regards the frequency of the maternal intentional communication (even if at a qualitative level the data trend seems to be similar). See Table 1 for details. Taking into consideration some subcategories of children's vocabulary, we found that eighteen month old children of the subgroups 2 and 3 can understand a big number of nouns of objects among the category of nouns while among the grammatical expressions they can understand more verbs and adjectives, respectively for $p < 0.01$ and $p < 0.05$. The variable frequency of the maternal intentional communication is also related to some aspects of the non-verbal communication measured through actions, communicative gestures, play and imitation produced by the eighteen month old children of our sample (see Table 2, actions and gestures). Actions and gestures with a communicative value, are more frequent in children of subgroup 2 than subgroup 1 ($p < 0.001$). Also the production of actions and communicative gestures in children of the third subgroup is superior to that of the children of the first subgroup ($p < 0.05$). Observing the subcategories we can see that in the imitation there is only a statistically significant difference among the performance of the children of subgroup 2 (average exposure) in comparison to those of low exposure ($p < 0.001$). See Table 2 for average values related to gestures and to actions with a communicative value of 18-month children. The analysis of the variables tone and characteristics of the maternal intentional communication has given no statistically significant association with the parameters of the linguistic or non-linguistic communication of the children of our sample.

Table 2
Averages Related to the Production of Communicative Gestures and Imitation Measured in 18-month Children According to the Frequency of the Maternal Intentional Communication

	<i>Daily Frequency of the Maternal Intentional Communication</i>		
	<i>Low</i>	<i>Average</i>	<i>High</i>
Actions and gestures	29.45	47.27***	42.28*
Imitation	4.63	10.44***	8.28

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The analysis of the variables related to children's sex and parents' profession and education has not underlined any statistically significant association with the indicators of the linguistic communicative development of the children of our sample. DISCUSSION In a sample of primigravidae we have compared the characteristics of the fetal sonorous experience and the subsequent communicative and linguistic development of their children. We have investigated partly the environmental stimuli and partly the stimulation coming from the maternal voice. First we have found out that a different quality and quantity of fetal acoustic exposure to the environmental sonorous stimuli (either from a generic noise or from specific, rich and complex sources, such as music, radio and television) has no relevance with the subsequent communicative and linguistic development of the children examined. We have been surprised to find out that in our sample there is no significant difference between children of women who during pregnancy listened to the radio, television or music less than an hour a day (low exposure) and children of women who listened to these sources for more than three hours a day (high exposure) since previous studies on the systematic exposure of the fetus to music have demonstrated an association with subsequent elevated prelinguistic behavior and certain cognitive gains in those children (Lafuente, Grifol, Segarra, Soriano, Gorba & Montesinos, 1998). In fact a greater or smaller auditive fetal exposure to linguistic, non-linguistic, musical or generic sonorous but 'impersonal' sources, naturally present in the mother's environment, don't seem to be associated to aspects of the communicative and linguistic development of ten or eighteen month old children of our sample. After having analyzed the environmental stimuli of the sonorous environment of the fetuses of our sample, we have considered the auditive stimulation of their mothers' voice. De Casper and Fifer (1980) have shown that fetus can recognize the maternal voice showing a preference for this after birth. Therefore we have distinguished the fetal auditive exposure to its mother's intentional linguistic communication from each non-intentional linguistic communication act. The analysis of this variable can't be associated with the variables of the communicative and linguistic development, underlining that, in our study, the exposure of the fetus to the maternal language, except for an intentional communication, cannot specifically be associated with the communicative and linguistic development of the children. By maternal intentional communication we mean the variable that is an intentional talking of the pregnant woman to her fetus. This variable has been investigated according to different dimensions of frequency, tone and characteristics. The analysis of the variables tone and characteristics of the maternal intentional communication, which investigated the tone of the voice, the type of linguistic or melodious expressions, used and the possible involvement of others in the communication, has not shown any significant association with the parameters of the linguistic or non-linguistic communication of our sample. Instead, the analysis of the variable frequency of the intentional maternal communication underlines two aspects of the communicative and linguistic development of eighteen month old children: the abilities of linguistic

understanding and the production of actions and communicative gestures. We can see that eighteen month old children, whose mothers belong to the subgroup of those who intentionally talked to the fetus two or three times a day (average exposure) and to the subgroup of those who intentionally talked to the fetus more than three times a day (high exposure), can understand more nouns and terms with grammatical function compared to those children whose mothers talked to them once a day (low exposure). Particularly, as we can observe in table 1, there is a difference of more than one hundred words between the children of the subgroup of an average exposure compared to the children of the subgroup of low exposure. Furthermore the average of actions and gestures with communicative value produced by eighteen-month-old children, underlines that these communicative forms are more consistent in the subgroup of a high and average exposure compared to those of a low exposure. It is interesting to notice that in some cases an average fetal exposure to the maternal intentional communication seems to have been more relevant than a high exposure (see categories: nouns and imitation in table 1, 2). From our study we have found out that the crucial element of the sonorous experience of the fetus seems to be bound only to one element: the frequency of the intentional maternal linguistic communication from mother to fetus. In our sample we can see that, in eighteen month old children, the understanding of the language shows differences according to the high, average or low prenatal exposure to the maternal intentional communication while the production of the language doesn't show any meaningful association with it. To understand such a result we have to take into consideration the characteristics of the language development. According to Caselli and Casadio (1995), the abilities of understanding come before those of linguistic production and they are quantitatively superior in the first two years of life. Furthermore the studies about the first linguistic development underline that an elevated ability in the understanding of the language in the first eighteen months represents a predictor index of subsequent cognitive and linguistic development (Caselli & Casadio, 1995). Likewise the production of actions and communicative gestures at this age is correlated with the understanding and is considered a predictor index of the cognitive and linguistics abilities of later phases (Caselli & Casadio, 1995). In our study the children belonging to the subgroups of high and average exposure to the maternal intentional communication seem to highlight some elements of subsequent richer cognitive and linguistic development. The variable intentional maternal communication is a complex one and it introduces different aspects. If we wanted to examine the sensorial aspect of the fetal auditive perception we could think that when its mother intentionally talks to it in uterus it would be particularly easy for the fetus to catch the sonorous stimulus consequently the growing nervous system and the developing cortical areas may receive a better and specific stimulation. Probably, the children of women belonging to the high, average subgroups can familiarize precociously with the language so becoming more sensitive to it. This might explain their understanding of a particularly wide vocabulary. Some studies demonstrate that children who underwent prenatal educational programs showed a more elevated communicative, cognitive and social development (Van de Carr & Lahrer, 1986, 1988; Manrique, 1998). Such programs involve daily exposure to auditive and tactile stimulation of the fetus from its parents. The purpose is to establish a communication with the fetus starting at 32 weeks, when it is able to hear and to react. In accordance we have found a similar result in the linguistic understanding and in the production of actions and gestures in our sample. As we have already seen in our study a maternal non-intentional communication cannot be associated with the communicative and linguistic development. Therefore it seems that the sensorial aspect is not very influential but that there are other factors to be taken into consideration bound to the maternal intentional communication. We believe that the variable maternal intentional communication reflects important aspects related to the mother personality and her way of relating with the unborn child. This aspect, which was not exactly the objective of our study, certainly suggests the need for subsequent studies, however we can make some reflections on the subject. In fact, if we take into consideration that 56 out of 58 women of this sample believed that the fetus could hear their voice, it is not amazing that they stated to talk to the fetus several times a day. Instead we found more unusual, as in the subgroup of low exposure, the expectant mothers talking once a day to the fetus. Considering that the

differences are evident in this subgroup we wonder what distinguishes mothers who often talk to the fetus from those who talk to it once a day. We believe that through delivery preparation courses women had started thinking that the fetus could hear, nevertheless in our sample two women believed that the fetus cannot hear and two others, even knowing that the fetus can hear, did not speak to it. In the case of those expecting mothers who spoke only once a day to the fetus we wonder if they were drawn by an attitude of complaisance or conformism saying they talked to the fetus instead of being little convinced of the real possibilities of the fetus to hear them. This aspect leads us to think about a small awareness of these mothers both of the fetus separateness, individuality and of the possibility to communicate with it. However, little talking to the fetus could simply point out a different communicative preference, here not examined. It seems that a pregnant woman who wants to talk to her fetus expresses a precise wish to get into communication with it. Speaking to her unborn child the mother communicates above all affectively, emotionally underlining the quality of the relationship and the mother's child representation. We can hypothesize that the women of our sample who intentionally talked to their unborn child in various ways, more times a day and in different moments of the day, showed a strong motivation to enter into communication with their child underlining a mental representation of their pre-nate child as person distinguished by themselves, putting themselves in relationship with it, sensing and representing its needs and feelings. Winnicott defined "primary maternal preoccupation" the attitude of a mother to identify with the child, to imagine its needs and to adapt sensitively with the child. He affirmed that this starts when a woman knows she is with a child (Winnicott, 1975). We have also wondered if very motivated mothers (as those belonging to subgroups 2, 3 of our study) could over-estimate their children's communicative and linguistic abilities. However this would not explain a greater association among some categories (e.g. nouns and imitation) and an average maternal intentional communication (not the high one) with the fetus. In fact there are elevated performances (e.g., nouns and imitation) among those children whose mothers said to have an average intentional communication. There is no significant difference among subgroup to average exposure and subgroup to high exposure, even if observing the results at a qualitative level it seems to appear an advantage from an average quantity of fetal exposition. This datum, which brings us back to Winnicott's "good enough mother", seems also to come from the actual studies on the attachment showing how children with secure attachment have parents who offer an intermediate quantity of parental care (Fonagy & Target, 2001). Finally, we can merely hypothesize that the frequency of the variable maternal intentional communication can link to the type of mother-fetus relationship in which the bond could settle down in different ways in the prenatal phases (Cranley, 1981). Therefore the advantage in the communicative and linguistic development of the children whose mothers often spoke to them in uterus connects to a type of mother-child relationship, which supports the subsequent development. From our sample the more remarkable fetal sonorous experience seems to be linked with a frequent maternal linguistic communication specifically concerning the fetus.

CONCLUSIONS After having examined the characteristics of the fetal sonorous experience as regards to the linguistic development in a sample of 58 primiparae and in their children, we have found that sources of generic environmental noise or complex specific stimulations as music, radio and television don't show statistically significant associations with the indicators of the communicative and linguistic development. In our sample the children of women who talk to them in uterus twice, thrice a day or more have a richer communicative skill and good abilities of understanding in comparison to those children whose mothers who talk to the fetus once a day. Therefore the fetal sonorous environment seems to be an environment fundamentally determined by an aspect of relationship between the mother and the fetus: in our study the words which the mother said to her child in uterus are the aspect of the sonorous environment which can relevantly influence the parameters of the following communicative and linguistic development. This result is notable in pointing out the influence of aspects which are more complex and bound to the quality of the mother-child relationship, rather than to the effects of the quality and quantity of the auditive stimulation "tout court." A future study might investigate such variables related to the type of mother-fetus relationship (Cranley, 1981) and on this basis investigating possible

differences in the parameters of the child cognitive, communicative and linguistic development. References

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