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Cochlear implant and lexical diversity development in deaf children: intra- and interindividual differences.

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1- Introduction

1.1 Language development in deaf children with implants

1 In children exhibiting severe bilateral deafness, conventional hearing aids are unable to deliver sufficient relevant information that permits the satisfactory development of oral communication. In such situations, the most suitable form of auditory rehabilitation is the cochlear implant which takes the form of a device, equipped with electrodes, introduced surgically into the inner ear. These electrodes, which are receptive to environmental sound information, stimulate the neurons in the spiral ganglion with nerve fibers going into the auditory nerve. This surgical technique has been approved for use in the United States by the FDA in 1980 for adults and 1990 for children. The cochlear implant thus facilitates patients' participation in oral communication by giving this population with severe hearing difficulties, access to the world of sound without, however, fully restoring their auditory capabilities. The thresholds with an implant are about 30 to 40 dB. Initial studies focused on the recovery of auditory capacities, the development of speech productions, and intelligibility. On average, children with hearing difficulties are able to perceive voice/silence alternations three months after activation of the implant which takes place one month after implantation (Truy, Jonas & Morgon, 1995). In addition, during this same period, these children start to identify certain noises in their sound environments, such as the rustling of paper (Uziel et al., 1992).The processing of environmental sounds then develops rapidly after this (Lenarz, 1997).

Initially, authors observed an increase in vocalizations which gradually gives way to the production of isolated words (Lenarz, 1997; Uziel et al., 1992). Language development in children with implants follows the same milestones as those of hearing children (production of isolated words, association of two words and then sentences) (Chin & Pisoni, 2000). While knowledge about the capacities for perception, discrimination and production is fairly extensive, very few studies have focused on a key aspect of language acquisition: the spontaneous use of language and its characteristics in conversational exchanges by children with implants (Deleau & Le Maner-Idrissi, 2005; Preisler, 2001) and even less in french-speaking children with cochlear-implants (Le Normand, 2004). Furthermore, researches have revealed the importance of certain factors in the appearance and mastery of verbal language in children with implants. Further analyses should be done to determine the relative influence of predictive variables on lexical development among cochlear implanted children (Le Normand, Ouellet & Cohen, 2003).

1.2. Variability of language development in deaf children with implants

2 The factors which have been particularly emphasized include: the onset of deafness - children with hearing difficulties who were once able to hear (as in the case of meningitis for example) obtain better results and do so more quickly in the process (Fryauf-Bertschy, Tyler, Kelsay & Gantz, 1992); the age of the child at implantation - early-implanted children achieve better performances (Anderson et al.,2004; Colleti et al., 2005); the level of stimulation within the family (Miyamoto, Kirk, Svirsky & Seghal, 2000; Preisler, 2001). Such results are of fundamental importance because they clearly indicate the need for a differential approach since the measured factors are independent of one another. However, we consider it is essential to understand the importance of each respective varying factor. Furthermore, this data is cross-sectional in nature and it is difficult to interpret the observed results: are they distinct, task-related results or do they indicate a broader, more stable phenomenon? Only a longitudinal study will make it possible to answer this question. It is also important to standardize the basis for the matching of subjects in terms of level of deafness, type of implant inserted and prior access to verbal language. We also consider it necessary to increase the number of participants in order to confirm the results obtained in early studies which have often involved only a small number of children.

3 We hypothesized that the insertion of an implant and the consequent access to auditive information should be followed by an increase in the number of different words used in spontaneous play interaction. The latter follows a different developmental process correlating to the age of the child at implantation, to the type of communication mode used before implantation, to the school integration level in a normal hearing environment (thus relating to the demands made on a verbal communication mode), and to the sex of the child.

2 - Method

2-1 Participants

4 The recruitment of our population is based on the general care protocol covering the selection of children eligible for implantation and on the medical, paramedical and psychological follow-up of those whose implantation was performed at the Cochlear Implant Center of the University Hospital in Rennes (France).

5 The sample consisted of thirty-eight preverbal, profoundly deaf children (17 girls and 21 boys), aged 2 years and 3 months to 5 years and 8 months with a mean age of 3 years and 8 months. They all received their implants at the Cochlear Implantation Center in Rennes and were given the same implant, MED EL Tempo+.

Table 1: Demographic and clinical characteristics

Child	Sex	Age at implantation (year; month)	Communication mode	School integration	Child	Sex	Age at implantation (year; month)	Communication mode	School integration
1	F	05.08	Cued speech	Tot. Int.	20	M	02.11	Cued speech	Deaf. Sch.
2	F	04.05	Signed French	Deaf. Sch.	21	F	02.11	Signed French	Deaf. Sch.
3	M	05.03	Cued speech	Tot. Int.	22	F	02.07	Signed French	None
4	F	03.05	Signed French	Tot. Int.	23	F	04.05	Signed French	Deaf. Sch.
5	M	02.07	Signed French	Tot. Int.	24	F	03.05	Signed French	Deaf. Sch.
6	M	04.04	Signed French	Deaf. Sch.	25	F	04.04	Signed French	Deaf. Sch.
7	M	04.08	Signed French	Deaf. Sch.	26	M	02.03	Signed French	Tot. Int.
8	M	03.04	Signed French	Deaf. Sch.	27	M	03.05	Signed French	Deaf. Sch.
9	F	02.03	Signed French	Tot. Int.	28	M	03.09	Cued speech	Tot. Int.
10	M	03.07	Cued speech	Tot. Int.	29	M	02.09	Signed French	Deaf. Sch.
11	F	02.09	Signed French	Tot. Int.	30	M	04.04	Signed French	Deaf. Sch.
12	M	03.05	Signed French	Deaf. Sch.	31	M	02.11	Signed French	Tot. Int.
13	F	05.01	Signed French	Deaf. Sch.	32	F	05.01	Signed French	Deaf. Sch.
14	M	03.07	Cued speech	Tot. Int.	33	M	03.11	Cued speech	Deaf. Sch.

15	F	05.03	Cued speech	Deaf. Sch.	34	F	02.09	Signed French	Tot. Int.
16	M	03.04	Cued speech	Tot. Int.	35	M	05.02	Signed French	Tot. Int.
17	M	03	Signed French	Tot. Int.	36	M	03.11	Cued speech	Deaf. Sch.
18	F	02.08	None	Deaf. Sch.	37	M	02.05	Signed French	Deaf. Sch.
19	F	03.02	Cued speech	Tot. Int.	38	F	04.07	Signed French	Deaf. Sch.

6 Tot. Int.: Total integration

7 Deaf. Sch.: Deaf school

2-2 Experimental protocol

8 The data was gathered in as normal a situation as possible, allowing us to observe the development of exchanges between the child and one of his/her parents (the mother in 90% of cases and the father in 10% of cases). These sessions were filmed at regular intervals in the speech pathologist's clinical office at the hospital. The first session took place the day before implantation with the following sessions being conducted every six months during the first year following activation of the implant (activation took place 1 month after insertion of the implant). These sessions lasted 7 minutes 30 seconds and the child/parent pairs were left alone after being instructed to play as they would at home. Thus protocol is standardized and widely accepted one (Le Normand, 2004; Tait, 1993; Tait, Lutman & Robinson, 2000). A set of 6 toys was available for each session: 4 small cars, a workbench, a farm and its animals, 2 telephones, a doll and its clothes, a toy dinner service.

2-3 Measures

9 To explore the children's production during the first year after implantation, lexical diversity (number of different words) seems the more appropriate indicator. In majority implanted children only produced isolated words during the first year after implantation. Sentences or two-word groups appear only during the second year after implantation. In fact measures as verbal fluency (total number of words and utterances) or mean length of utterance (MLU: number of total words/number of utterances) could be used only when the child products more than 50 utterances (Le Normand et al., 2003) and it was not the case of implanted children one year after implantation. A prior study indicates the gradually effective growth of vocabulary during the first year (Le Maner-Idrissi et al., 2008).

10 Classical ratio of "type" and "token" was not used since it was less appropriate for the study of variability. In fact, a ratio minimised difference and is more difficult to establish at a multilevel regression analysis. TTR was neither applied due to very low reliability and validity indexes in the case wherein the number of tokens varies a lot (Klatter-Folmer, Kolen, Roeland Van Hout & Verhoeten, 2006) and it's precisely the case for implanted children only one year after implantation.

11 To evaluate lexical diversity we take into account different words, so for example when a child repeats ten times a word during the session this word will be posted only once. Onomatopoeic words and interjections are not included.

12 In the light of the existing research cited above, we decided to evaluate the effect of the child's age at the time of implantation together with the preferred mode of communication prior to implantation (oral aided by Cued Speech[1] *vs* signed communication). The type of schooling (school integration in a normal hearing environment *vs* schooling in a special needs school environment at the age of 2) was also taken into account. We did not include in our study children who had changed schooling environments. As far as this variable is concerned, we decided to focus on the stimulus received from the non-family environment by taking into account the type of schooling administered to the child with implant. The deaf children integrated in a school attended by hearing children tended to receive more demands in terms of verbal communication than children who primarily interacted with other deaf children. Furthermore, in hearing children, the most frequently investigated intrinsic factor within the framework of language acquisition is sex (Kern, 2003; Le Normand, Parisse & Cohen, 2008). Many studies have shown that girls acquire language earlier than boys and possess a richer vocabulary (Fenson et al., 1994; Kern, 2003). As a result, we considered it important to measure the possible effect of this variable on the development of productions in children. Dual-coding was performed for the four most productive children (10% of the sample) and the percentage of inter-rater agreement of transcriptions was 97.91%.

13 **2.4. Presentation of the employed analytical method: multilevel regression analysis**

14 When repeated data simultaneously gathered from all subjects on each occasionis processed and no missing data observed, it is possible to use conventional analytical techniques such as repeated measures analyses of variance. However, in longitudinal studies, the data is often asynchronous (different intervals between observations for different subjects). There are at times different number of observations for various subjects. In this case, the use of analyses of variance is not recommended. One possible alternative is to take the form of multilevel modeling (Hox, 2000). The data collected in this study is particularly well suited to this type of model which generally permits the processing of data characterized by a hierarchical structure (Kreft & de Leeuw, 1998). A hierarchy means that low-level observations are embedded in one or more higher levels (for example, pupils can be embedded in classes which, in turn, can be embedded in schools... etc). In this case, namely in the presence of longitudinal data, we may consider that it is the repeated measures (level 1) that are embedded in each subject (level 2). There are various classes of multilevel model. A distinction is particularly made between multilevel structural equation models and multilevel regression analyses (Hox, 2000). It is this latter type of analysis that will be presented here. It represents an extension to the multiple regression model (Snijders & Bosker, 1999).

15 These analyses require at least three measurement points and can combine two models:

16 a/ A within-subject model making it possible to study the intra-individual change by adjusting a growth model (estimation for each subject of an "intercept" parameter - initial status of the variable evaluated several times) to the repeated data measured for each subject and a "slope" parameter (growth rate). This growth model can be linear (growth is then considered to be a linear function of time) or more complex.

17 b/ A between-subjects model intended to analyze the inter-individual differences in the individual parameters of the growth curves. At this level, we therefore attempt to explain the respective variances in the "slope" and "intercept" parameters in terms of individual and/or contextual characteristics (explanatory variables).

18 Given the small number of observations made for each subject in our study (3 measurement dates), we chose a linear growth model using the HLM5 software (Raudenbush, Brik, Fai Cheong & Congdon, 2000). The multilevel analysis that we performed, known as the Hierarchical Linear Model (Brick & Raudenbush, 1992), is based on a comparison of the fits of embedded models (null models, monotonous linear growth models, unconditional and then conditional models as described below). The indicator of goodness of fit is deviance (= -2 log likelihood). It is associated with a number of parameters which depends on the number of coefficients to be estimated in the model (in the case in question, using the Ordinary Least Square method - OLS). The lower the deviance, the better the fit of the model is. The difference between the deviancies of two embedded models obeys a chi square law with a degree of freedom which corresponds to the difference between the number of parameters of each of the two compared models. In the results tables which follow (tables 1 and 2), the fixed effects correspond to the general effects. In an unconditional linear model (see table 1), there are two fixed coefficients: the first corresponds to the mean intercept (or mean initial status, i.e. in this study, the mean initial level of the children lexicon) and the second corresponds to the mean slope (or mean growth rate, i.e., the mean growth rate of the children lexicon over the period of the study). The random effects correspond to the individual variations around a central tendency. These effects are said to be random because we suppose that they follow a normal distribution with a mean equal to 0. In an unconditional model (see table 1), there are three random coefficients: the first corresponds to the inter-individual variations around the mean intercept, while the second refers to the inter-individual variations around the mean slope and the third to the intra-individual variations of the subjects around their own means (these latter variations are, in effect, confounded with the measurement error). We start the analysis with the simplest model (3 parameters to be estimated: 1 fixed coefficient (β_{00})and 2 random coefficients (r_{0i} and e_{ti})), i.e. the *null model* which is based on the hypothesis of stability over time for all the subjects:

Null model:
Level 1 (within-subject): $\mathbf{Y_{ti} = \pi_{0i} + e_{ti}}$
$\mathbf{Y_{ti}}$ = observed lexicon scores collected from children i over the t measurement times (t=3 in the study) - ξ_{0i}= estimated individual intercepts (i.e., estimated initial individual levels of lexicon) - $\mathbf{e_{ti}}$= random error in the measurement of Y (lexicon scores) for the children i (i.e., intra-individual variations of subjects around their own means).
Level 2 (between-subjects): $\mathbf{\pi_{0i} = \beta_{00} + r_{0i}}$
β_{00}= mean intercept (i.e., only for the null model, which supposes stability over time for all the subjects, general mean over the 3 measurement times) - $\mathbf{r_{0i}}$= inter-individual variations of the individual intercepts around the mean intercept.

19 The goodness of fit indicator of this null model with its deviance, is then compared to the deviance obtained when using a second model known as a *monotonous linear growth model* (4 parameters: 2 fixed coefficients (β_{00} and β_{10})and 2 random coefficients (r_{0i} and e_{ti})). The hypothesis here is one of general growth: we suppose that all the subjects change in

the same way (identical slopes), they differ from one another only in terms of the intercept (initial status):

Monotonous linear growth model:
Level 1: $\mathbf{Y_{ti} = \pi_{0i} + \pi_{1i}\, t + e_{ti}}$
ξ_{1i} = estimated individual slopes (i.e., estimated growth rate in Y (lexicon scores) for each child i over the 3 measurement times)
Level 2: $\mathbf{\pi_{0i} = \beta_{00} + r_{0i}}$
$\mathbf{\pi_{1i} = \beta_{10}}$
β_{00}= mean intercept (or mean initial status, i.e., mean level of lexicon scores at t_0) - β_{10}= mean slope (i.e., mean growth rate of lexicon scores over the 3 measurement times)
(Y_{ti}, π_{0i} , e_{ti} and r_{0i} have already been defined before (see Null model)).

20 If this model is better fitted to the data than the previous one (significant reduction in deviance), a third model can also be tested: an *unconditional model* (6 parameters: 2 fixed coefficients (β_{00} and β_{10}), 3 random coefficients (r_{0i}, e_{ti} and r_{1i}) and 1 covariance between individual slopes and intercepts). We can then hypothesize that the slopes and intercepts vary between subjects:

Unconditional model:
Level 1: $\mathbf{Y_{ti} = \pi_{0i} + \pi_{1i}\, t + e_{ti}}$
Level 2: $\mathbf{\pi_{0i} = \beta_{00} + r_{0i}}$
$\mathbf{\pi_{1i} = \beta_{10} + r_{1i}}$
$\mathbf{r_{1i}}$= inter-individual variations of the individual slopes around the mean slope
(All the other parameters have already been defined previously.)

21 Finally, if we observe a fall in deviance again, it is still possible to test a fourth model: a *conditional model* (6 + "x" parameters where "x" refers to the number of regression coefficients to be estimated) in which, with the introduction of individual and/or contextual characteristics (predictor or explanatory variables), we attempt to explain the respective variances of the individual slope and intercept parameters (in cases where these variances are significant):

Conditional model:

Level 1: $Y_{ti} = \pi_{0i} + \pi_{1i} t + e_{ti}$

Level 2: $\pi_{0i} = \beta_{00} + \beta_{01} X_{1i} + \beta_{02} X_{2i} + \beta_{03} X_{3i} + \beta_{04} X_{4i} + r_{0i}$

$\pi_{1i} = \beta_{10} + \beta_{11} X_{1i} + \beta_{12} X_{2i} + \beta_{13} X_{3i} + \beta_{14} X_{4i} + r_{1i}$

X_{1i} **to** X_{4i}= predictor variables: Sex;Age of Implantation; Communication Mode;Type of schooling

β_{00} and β_{10} are the intercepts of the two regression equations

β_{01} **to** β_{04} = regression coefficients (influences of the predictor variables) on the mean intercept (mean initial status, i.e., mean level of lexicon scores at t_0) of the children lexicon scores

β_{11} **to** β_{14} = regression coefficients (influences of the predictor variables) on the mean growth rate of the children lexicon scores

(All the other parameters have already been defined previously.)

3 – Results

22 In line with the procedure which has just been presented, various models were tested on the repeated data corresponding to the level of the children lexicon scores. The monotonous linear growth model is significantly better fitted to the data than the null model [Δ Deviance = 35.17; Δ number of parameters = 1;$p<.01$]; the unconditional model (table 1) is significantly better fitted to the data than the monotonous linear growth model [Δ Deviance = 56.96; Δ number of parameters = 2; $p<.01$] and, finally, the conditional model (table 2) is significantly better fitted to the data than the unconditional model [Δ Deviance = 19.63; Δ number of parameters =5; $p<.05$]. It is these latter two models that are presented below (tables 1 and 2):

Table 2: Linear model of growth in the children lexicon scores (unconditional model (i.e., no explanatory variables introduced in the model)).

Fixed effect	**Coefficient**	**Standard error**	**df**	**p**
Mean initial status, β_{00}	2.191	1.126	37	.059
Mean growth rate, β_{10}	10.341	1.821	37	<.001
Random effect	**Variance**	**Df**	**χ^2**	**p**
Initial status, r_{0i}	4.678	37	38.528	.400
Growth rate, r_{1i}	100.816	37	152.825	<.001
Level 1 random error, e_{ti}	59.275			

23 The mean initial status (mean intercept) in the level of the children lexicon is 2,191 words. This mean is not significantly different from 0 ($p=.059$), with a non significant variance of 4.678 ($p=.40$). The initial level of lexicon of all the children studied was very low. The individual slopes (individual growth rates) were distributed with a significant variance of 100.816 (standard deviation = 10.04) around the mean positive growth rate of

10.341 (mean growth rate (or mean slope) significantly different from 0). Some subjects therefore seem to exhibit a negative slope (this was indeed the case for three children, but with very weak slopes). The covariance between individual slopes and intercepts is 21.238: when the initial level of the children lexicon is high, growth in lexicon is faster and vice-versa.

24 In summary, the unconditional model results support the presence of a rather important individual linear rate of change variability of the lexicon level over the three observations, but not the variability of the initial lexicon level (intercept) of the children studied.

25 The table below shows the between-subjects conditional equations in which the variation of the within-subject estimated growth rate parameters is modeled with the hypothesized explanatory variables studied (Table 3).

Table 3: Linear growth model in the children lexicon scores. Effects of the predictor variables Sex, Age of Implantation, Communication Mode and Type of schooling on growth rate of the children lexicon scores (conditional model).

Fixed effect	**Coefficient**	**Standard error**	**Df**	**p**
Model for initial status, π_{0i}				
Mean initial status, β_{00}	2.169	1.134	37	..063
Model for growth rate, π_{1i}				
Intercept, β_{10}	-8.158	7.623	33	.293
Sex, β_{11}	5.308	3.556	33	.145
Age of Implantation, β_{12}	0.101	0.145	33	.490
Communication Mode, β_{13}	3.973	4.709	33	.405
Type of schooling, β_{14}	12.024	3.209	33	**.001**

Random effect	**Variance**	**Df**	**X^2**	**p**
Initial status, r_{0i}	2.177	37	37.563	.443
Growth rate, r_{1i}	91..92	33	124.347	<.001
Level 1 random error, e_{ti}	60..791			
Model	**Growth rate variance (π_{1i})**			

Unconditional	100.816
Conditional (with 4 co-variables)	91.92
Proportion of explained variance	8.82%

26 No explanatory variables were introduced in the model to explain the variance of the initial status, i.e., the variance of the lexicon scores at t_0, because this variance was non significant (see table 2). Of the four explanatory variables introduced in the model (Sex, Age of implantation, Communication mode and Type of schooling), only the Type of schooling variable made it possible to predict inter-individual variations in the growth rate of the children lexicon scores ([illegible]$_{14}$ = 12.024; p = .001): the children integrated in a hearing environment were the ones who exhibited the fastest increase in lexicon level over the period of the study. Finally, it should be noted that the four explanatory variables accounted for only 8.82% of the variance in the growth rate of lexicon scores. Other explanatory variables should probably be taken into account in next studies.

4 - Discussion

27 We hypothesized that the insertion of an implant and the consequent access to sound information should be followed by an increase in the number of different words used in spontaneous play interaction which follows different developmental trajectories. It was our opinion that the access to lexical diversity would be in function of the sex of the child, the age of implantation, the type of communication mode before implantation and the level of school integration (extent to which the verbal mode of communication was solicited) in a hearing environment. Results must obviously be replicated on a bigger scale to achieve better reliability. But nevertheless, they tend to show that only school integration in a hearing environment seems to be a determining factor with regard to the lexical diversity development in deaf children who have received implants. The demands made by age group peers seem to favor the use of verbal language and cause it to develop at a faster rate. It is also possible that the fully integrated school children are the ones who originally exhibited a greater desire and ability to interact with hearing children and whose parents were therefore prepared to integrate them in a hearing school environment at an earlier age. It does not seem possible to explain these differences in terms of the language level prior to implantation since the differences between the groups observed before implantation were not significant.

28 In contrast, unlike in hearing children, we observe no sex-related differences in children with implants, at least during the first year following the implant. We also observe no effect relating to the prior use of CS (Cued Speech). This result can doubtlessly be explained in terms of the small number of subjects who knew how to use this code before receiving the implant (11). The age of implantation also seems to have no effect on the lexical diversity whereas, as we have already seen, numerous studies have shown that the younger the child is at the time of implantation, the better his or her performances are. This result can be explained in terms of the small number of subjects who are very young. In fact, age seems do have an effect on language acquisition when children were implanted between the age of one and three. In our study only 12 children were between

two and three years old. None were implanted before two years old. Such results are also due to the type of measurement performed. In the research cited above, the clinicians evaluated the subjects' auditory discrimination and production capacities in a test situation whereas in our study, we focused on the evaluation of the increase in the number of different words used in a spontaneous play interaction since this requires the children's mastery of at least the basic rules of conversation, a skill not yet acquired or mastered by very young children. It is also possible that the number of different words used in a session is not sufficient to show an age effect. Such measure of spontaneous language has its limits and it would be necessary to evaluate others aspects of language as verbal fluency, grammatical production with mean length of utterances for example (Le Normand & al., 2003). In this study, we only focused on lexical importance in one specific context. This however, must be contrasted with other situations as well.

29 Although this research clearly sheds some light on the issues that concern us, we wish to continue our investigation by extending this longitudinal follow-up to a second year in order to study the stability of the differentiated developmental profiles identified during the first year. At the same time, we wish to undertake an analysis of the type of intra-family stimuli received, by focusing on the specific characteristics of the speech of parents filmed in the presence of their children. Moreover, it would be important to confirm these first results by extending the number of participants. By taking into account other factors such as cognitive development, personality, etc., this will help us achieve a better far-reaching interpretation of these initial data.

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NOTES

1. Cued Speech helps deaf children acquire an understanding of spoken language by making visible the vocabulary and structure of spoken language. It uses eight hand-shapes in four different positions near the mouth to clarify the lip patterns of normal speech.

ABSTRACTS

Cochlear implants help children with severe hearing difficulties achieve access to verbal language. We possess evidence of the capacities of perception and discrimination skills as well as knowledge relating to the development of verbal productions and intelligibility. In contrast, little work has been undertaken concerning the spontaneous use of language by children with implants in interactions with their friends and family. At the same time, the high level of variability observed in the language acquisition speed profiles has led us to consider the role of a number of variables. We hypothesized that the insertion of an implant and the consequent access to sound information should be followed by an increase in the number of different words used in spontaneous play interaction. The latter follows a different developmental process correlating to the age of the child at implantation, to the type of communication mode used before implantation, to the school integration level in a normal hearing environment (thus relating to the demands made on a verbal communication mode), and to the sex of the child. 38 pre-lingually deaf children (mean age: 3;08) using cochlear implants were filmed at regular intervals over a period of a year. Results tend to show that only school integration in a hearing environment seems to be a determining factor with regard to the development of lexical diversity in deaf children who have received implants. The demands made by age group peers seem to favor the use of verbal language and cause it to develop at a faster rate.

L'implant cochléaire permet à des enfants atteints de surdité profonde, l'accès au langage verbal. Nous disposons actuellement de données sur les stratégies de traitement de l'information sonore, en revanche peu de travaux portent sur l'usage spontané du langage de l'enfant implanté avec son entourage. Par ailleurs, la forte variabilité observée dans les profils de vitesse d'acquisition du langage nous a menés à nous interroger sur le rôle de plusieurs variables. Nous avons supposé quela pose d'un implant et donc l'accès aux informations sonores, devrait s'accompagner d'une augmentation du nombre de mots différents utilisés au cours des interactions. Cette augmentation progressive de la diversité lexicale devrait s'effectuer selon des parcours de développement différenciés qui seraient indexés sur l'âge de l'enfant à l'implantation, le mode de communication privilégié avant l'implantation (communication orale *vs* signée), le type de scolarisation (intégration dans un milieu entendant *vs* école spécialisée) ainsi que le sexe de l'enfant. 38 enfants sourds (moyenne d'âge : 3 ;08 ans) prélinguaux implantés ont été filmés, à intervalle régulier, pendant une année. Les résultats tendent à montrer que l'intégration scolaire des enfants sourds implantés, en milieu entendant serait déterminante dans le développement de la diversité lexicale et l'usage spontané du langage verbal. De tels résultats semblent indiquer que les sollicitations des pairs favoriseraient l'usage du langage verbal et participeraient de ce fait à une maîtrise plus rapide d'une plus grande richesse lexicale.

INDEX

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