Verbal and visuo-spatial working memory capacities of deaf children with a cochlear implant compared with their hearing peers

Stéphanie Pouyat-Houée, Christine Gaux, Annick Weil-Barais

Verbal and visuo-spatial working memory capacities of deaf children with a cochlear implant compared with their hearing peers.

Pouyat Houée S[1,2,3]., Gaux C[1,2]., & Weil Barais A[1,2].

[1]Laboratoire de Psychologie des Pays de la Loire, [2]Université d'Angers & [3]Centre Charlotte Blouin d'Angers, France

Poster presented at 13th International Conference on Cochlear Implants and other Implantable Auditory Technologies, Munich, Germany June 18-21,2014

INTRODUCTION

We still have little information on the development it has for the deaf child and even less on the nature of the representations used by the deaf child to memorize verbal or visuo-spatial information. Being cochlear implanted does not allow acquiring the oral language immediately. Even when the implantation is early, visual information (lip reading and Cued Speech) improves oral language perception. Leybeart and Colin (2007) noticed the interest of exposing the CI children very early to French Cued Speech perception. Besides the works concerning the linguistic incidences of the CI pediatric, some studies examined the impact of the CI on the short-term memorization of information. Some people observe that the simultaneous presentation of hearing and visual modalities of the information would have a deleterious effect on the memorization. Bertoncini and Busquet (2011) think that the early-implanted children do not function any more as congenital deaf children who did not take advantage of rehabilitation. It is thus necessary to look for a complementarity coherent between the visual and hearing ways. A better understanding of the strategies of immediate memorization of information could bring elements of answer to these various questions.

METHOD

Participants :

14 deaf children with cochlear implant (S) and 14 hearing children (E) were matched according to their real age.

Deaf children with cochlear implant (S) :

- 6 males and 8 females ; mean age: 7;7 years
- 5 CP (First year of primary school) and 9 CE1 (Second years of primary school)
- born to hearing parents and prelingually deaf (profound and congenital)
- mean age of implantation: 2;7 years
- no additional developmental or cognitive delays other than hearing loss.
- used total communication or oral communication (lip reading and/ or Cued Speech)

Hearing children (E) :

- 6 males and 8 females ; mean age 7; 5 years
- 5 CP (First year of primary school) and 9 CE1 (Second years of primary school)

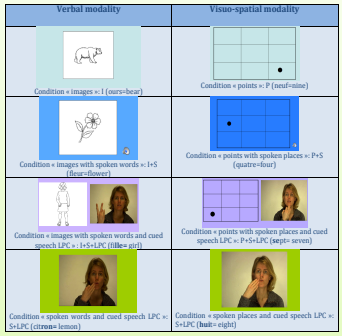
Procedure:

The children were tested individually and had to memorize:

- series of images : Concrete objects or Animals :
- Words from the database Manulex, level CP (First
- year of primary school)
- or series of point locations in a grid (adaptation of Corsi test) **for an immediate recall in the order**.

The series were presented one at a time, with sound and / or Cued Speech (that is with manual cues) and with four conditions.

We have tried to know which condition is the most favourable to memorize a verbal or a visuo-spatial piece of information and which type of information (verbal or visuo-spatial) is the best memorized.



RESULTS AND DISCUSSION

1. Verbal modality

Group effect: The number of reminded words, without differentiating the conditions, is more important for the hearing (E: 21,84/27) than for the deaf (S: 16,15/27) [F(1,26)=13,13; p<0,01].

Condition effect (without differentiating the groups): The scores are not significantly different according to the condition (I=19,57 ; I+S=19,14 ; I+S+LPC= 18,23 ; S+LPC= 19,04 [F(3,78)=1,17; ns].

The **comparisons two – two** indicate that, for deaf children S , the difference is significant between the conditions I / I+S+LPC [10,70**] and I+S / I+S+LPC [5,68*].

Interaction effect group*condition: The effect of interaction is not significant [F(3,78)=2,11; ns]. However, the gap between the deaf (S) and the hearing (E) children is more important for the conditions I+S+LPC and S+LPC (gap for I = 5,57; for I+S = 5,71; for I +S+LPC= 6,96 ; for S+LPC= 6,5).

Discussion:

The addition of the sound in the image, that is the simultaneous naming of the images, does not benefit to the deaf children. This result confirms that of Cleary & al. (2001). They suggest that during this task the children encode the visual information and do not use spontaneously a phonological coding. Furthermore, we observe that the contribution of the Cued Speech does not seem to help the deaf child in this memorization task. It is possible that the child has too much information to treat and that the Cued Speech becomes disturbing in this memorization task. Burkholer and Pisoni (2006) reported that when a CI child using total communication methods such as signed language or Cued Speech is confronted with manual signs, his or her attention will be drawn to the hand(s) of the speaker in addition to the lips on the speaker's face. Indeed, the child can have difficulty guiding his or her visual attention to the image and/or the Cued Speech.

2. Visuo- spatial modality

Group effect : The number of reminded words, without differentiating the conditions, is more important for the hearing (E: 24,87/27) than for the deaf (S: 23,23/27) [F(1,26)=2,33; ns].

Condition effect (without differentiating the groups): The scores are significantly different according to the condition (P=25,00 ; P+S=24,46 ; P+S+LPC= 23,71; S +LPC= 23,04 [F(3,78)=4,32; p<.01].

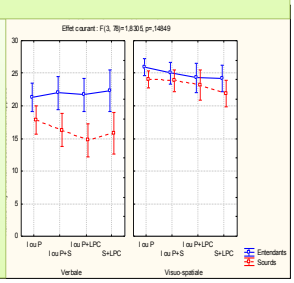
The **comparisons two – two** indicate that, for deaf children S, two significant differences between the conditions S+LPC / P (7,85**) and the conditions P+S /S +LPC (6,94*).

Interaction effect group*condition: The effect of interaction is not significant [F(3,78)=2,11; ns]. However, the gap between the deaf S and the hearing E children is more important for the condition S+LPC (gap for P = 1,86; for P+S =1,21; for I+S+LPC=1,15; for S+LPC= 2,35).

Discussion:

The scores are high for both groups. During this memorization task, it is not necessary to use a hearing aid, or Cued Speech. These children are able to take into consideration or not, the concurrent presence of sound and Cued Speech during the memorization. However, the absence of images seems more harmful for them deaf children S (for S+LPC).

Fig 1: Average number of correctly reproduced items (in the order on 27) by hearing (E) and deaf (S) children according to the verbal or visuo-spatial modality and to the condition of presentation.



3. Profiles of the capacities of memorization of the deaf children

It is interesting to observe that we find in the first two groups late-implanted children with a total communication but also children very early implanted with an oral communication. The results of these experiments suggest that differences in neural reorganization of multiple brain systems resulting from a period of profound deafness and language delay may be responsible for the enormous variability observed in speech and language outcome measures following implantation (Pisoni & al, 2010).

In the summary table below, we have the deaf children's performances in each of the conditions according to their profile. Score of recall below average Hearings (E) -1,65 standard deviation in green and score of recall over average Hearings E + 1 standard deviation in blue.

Deaf	Sexe	School Level	AGE (month)	Termo	I	I+S	I+S+LPC	S+LPC	P	P+S	P+S+LPC	S+LPC
					v	v	v	v	vs	vs	vs	vs
Difficulties of memorization												
1	M	CE1	96	B=C	12	9	7	13	26	22	25	20
2	M	CE1	95	B<C	17	13	14	16	27	26	27	24
8	F	CE1	104	B<C	18	16	12	23	27	27	27	22
9	M	CE1	107	B<C	13	11	11	13	26	26	27	27
14	M	CP	93	B<C	13	12	10	12	25	26	27	22
3	F	CP	87	B<C	21	17	22	13	22	22	24	15
4	F	CP	78	B>C	14	15	12	5	18	16	15	13
10	F	CP	84	B=C	13	10	11	6	19	25	21	21
11	F	CE1	100	B>C	20	12	11	6	21	19	8	20
16	M	CP	76	B>C	19	18	15,5	17	21	20	21	20
In the average												
7	F	CE1	88	B<C	17	24	18	25	27	25	23	26
12	F	CE1	102	B=C	20	19	16	19	24	26	26	24
Early												
6	F	CE1	84	B=C	27	27	27	27	27	27	27	25
13	F	CE1	93	B<C	25	25	20	26	27	27	26	27

CONTACT

stephanie.pouyat-houee@mfam49-53.fr

Bertoncini, J. & Busquet, D. (2011). La découverte de la parole : L'enfant entendant, l'enfant sourd porteur d'implant cochléaire et la LPC : une histoire d'adaptabilité. In J. Leybeart (Ed.). *La langue française parlée et complétée : Fondements et perspectives* (pp.209-226) Marseille: Solal Editeur

Burkholder, R.A., & Pisoni, D.B. (2006). Working memory capacity, verbal rehearsal speech, and scanning in deaf children with cochlear implants. In P. Spencer and M. Marschark (eds). *Spoken language development in deaf children* (pp. 328-359). Oxford : University Press.

Cleary, M., Pisoni, D.B., & Geers A.E. (2001). Some measures of verbal and spatial working memory in eight and nine-year-old hearing-impaired children with cochlear implants. *Ear and Hearing, 22*, 395-411.

Leybaert, J. & Colin, C. (2007). Rôle des informations visuelles dans le développement du langage de l'enfant sourd muni d'un implant cochléaire, *Enfance, 59*, 245-253.

Pisoni, DB., Conway, CM., Kronenberger,WG.,Henning,S, Anaya,E. (2010).Executive function and cognitive control in deaf children with cochlear implants. In: Marschark, MS.,editor. Oxford Handbook of Deaf Studies, language, and Education. 2. Vol. 1.New York: Oxford University Press.

Pouyat-Houée, S., Gaux, C. & Weil-Barais, A. (2012). Les capacités verbales et visuo-spatiales en mémoire de travail des enfants sourds munis d'un implant cochléaire, *Connaissances Surdité, 39*, 23-28.