

# Evaluation of the Effects of Prolonged Cued Speech Practice Upon the Reception of Spoken Language<sup>1</sup>

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It is widely recognized that, whatever educational method is utilized, whether oral or manual, the majority of profoundly deaf school leavers of today have not acquired adequate mastery of spoken and written language (Conrad, 1979). The cause for this unsatisfactory situation is often identified as the lack of adequate communication in the early period, reported to be the most favorable for language acquisition (Périer and Bochner-Wuidar 1981). There is evidence that brain plasticity is at its highest during these early years, and that the fundamental functions of language need to be established at that period in order to ensure normal development of later stages. When these functions are not well established, as is usually the case for profoundly deaf children, they enter primary school with not only a sensory impairment, but also a language handicap.

In oral education, the difficulty of communication calls for numerous tedious repetitions, slowing down the teaching process in school, and producing adverse psychological consequences in several students. In the absence of a reliable phonological code as a basis for the acquisition of reading skills, these do not usually reach an appropriate level either for the transmission of information in the written form, or for reaching reading pleasure.

The above considerations led the Brussels Integrated School (IS) and the Audio-phonological Center (Centre Comprendre et Parler) to decide in 1980 that a more efficient communication system than the exclusively audio-oral one previously used had to be made available to deaf children and their parents. Claims that this effectively permitted deaf children to develop linguistic competence at a rate and to an extent closely approximating that of their normally hearing peers had been made by Hilde Schlesinger (1978), using bimodal communication, and Orin Cornett (1967), through the consistent practice of Cued Speech (CS). The latter method has been shown by Nicholls (1979) and Nicholls and Ling (1982) to clarify the visual reception of spoken language. Its consistent use in St. Gabriel's School for the Deaf, Australia, was reported to have considerably changed teaching practice, making oral presentations much more efficient, and thereby reducing the need for repetitions or clarification by other communication means such as signs or writing.

CS was introduced during the Spring of 1980 in the early training and parental guidance program of the Centre Comprendre et Parler (CCP), and from the September start of the school year in all grade levels of IS: nursery (2½ to 5½), primary—preparatory (6 to 12 or 13), and secondary 13 or 14 to 18 or more). In the early training and parental guidance program, parents were given the choice between CS and bimodal communication using Signed French (SF). The latter was also introduced in the smaller age group nursery classes of the school, in the beginning of 1981, when it was realized that CS alone was not sufficient to establish good communication with small deaf children without language who had not benefited from early training with that method. For the majority of preschool and nursery school children, a combination between SF and CS has proved most efficient for establishing communication and developing linguistic competence.

Several young deaf children whose parents utilized consistently CS or CS-SF combination in early preschool training (starting during the first or second year of life) are indeed developing their language at a much more rapid rate than when exclusively oral methods were utilized. Some of them have a language proficiency, both receptively and expressively, which is on a par with that of normally hearing peers. They are integrated in classes of normally hearing children where they benefit from the help of a CS interpreter or where the class teacher herself utilizes CS with the whole class. In the IS, CS is utilized consistently in the secondary section and in several classes of the primary section. In other classes where part of the children do not benefit from CS, bimodal communication with SF is continued, while efforts are made to transfer progressively their SF competence to a capacity for CS reception. When the children's reception abilities allow the consistent use of CS, the teachers experience a greater efficiency of oral communication, and the possibility of more rapidly expanding the children's vocabulary and grammatical competence.

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The research project which will be described is still in progress, so that only partial results can be presented. It is hoped that when completed, this project will allow better understanding of the reasons for the differences in ability of different children to utilize CS, and indicate what measures might be appropriate to enhance the ability of the lower-performing subjects.

The research has several objectives:

- 1) to verify that the French version of Cued Speech--Langage Parlé Complété (LPC)--does in fact allow good visual reception of spoken language, by removing the ambiguities of speechreading (lipreading) and affording adequate visual information concerning the phonemes that are not visible on the lips.
- 2) to gain some insight about the factors determining individual differences in benefits from the method for the reception of spoken language.
- 3) to investigate the possible effect of consistent exposure to CS upon the speechreading capacities without the cues.
- 4) to investigate whether the phonological information made available by CS is stored and utilized in activities involving inner speech codes like reading and writing.

## Method

For the first phase of the project, a spoken language reception test was prepared. It was designed so as to test the subjects' perceptual capacities independently from their linguistic competence. To achieve this aim, the test was constructed with limited linguistic material, well known by the subjects. The items consisted of sentences with the same simple syntactic structure: subject - verb - complement. They were presented by a feminine speaker selected for clear, though not exaggerated, articulation. She was video-recorded on U-Matic  $\frac{3}{4}$  inch color tape. For the tests, the tape was projected on the screen of a monitor with a single loudspeaker, adjusted so as to produce a 70 dB A sound pressure level at one meter. Each sentence was spoken either with or without the cues. It was presented twice in immediate succession so as to minimize the attention variable. After the second presentation, the subject received a card with four pictures and had to show the one which corresponded to the spoken sentence. Each group of sentences illustrated on a given card was assembled so as to represent one of three different conditions of choice: easy (E), medium (M), or difficult (D). The difficulty was neither lexical, nor grammatical, but related to the greater or lesser degree of similarity of the visual pattern available for speechreading.

Examples of the E condition include:

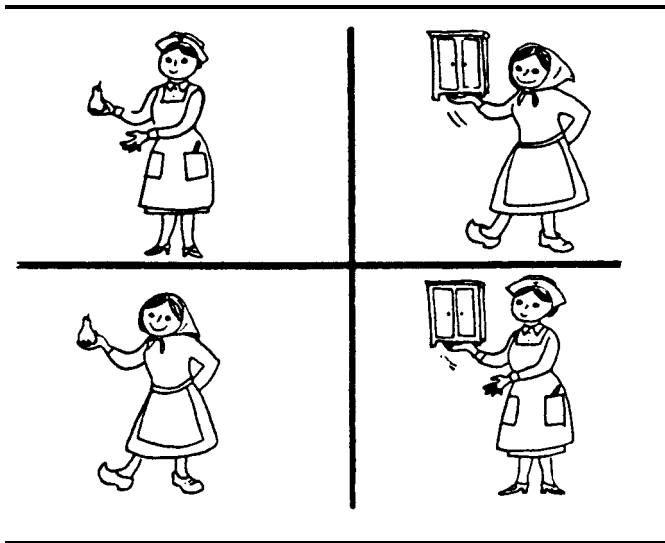
- Il montre le gateau.* (He shows the cake.)
- Le sac est lourd.* (The bag is heavy.)
- Il prend une robe.* (He takes a dress.)
- Les oeufs sont noirs.* (The eggs are black.)

The sentence presented was "*Il montre le gateau.*" The task was an easy one since both important "*montre*" and "*gateau*" are easy to discriminate from their competitors by lipreading. The identification of only one of these words was therefore sufficient to choose between the four possibilities.

The M condition is represented by:

- La poule est chaude.* (The hen is hot.)
- La frite est chaude* (The chip is hot.)
- La frite est jaune* (The chip is yellow.)
- La moule est jaune* (The hen is yellow.)

The target sentence here was "*La frite est jaune.*" It was easy to choose by lipreading distinction between "*frite*" and "*poule*" but "*jaune*" /ʒon/ and "*chaude*" /ʃod/, nearly identical on the lips, were difficult to distinguish.



**Figure 1 Example of the D (difficult) Condition**

The D condition is represented by the example illustrated in Figure 1.

- La fermière porte la poire.* (The farmer's wife is carrying the pear.)
- La fermière porte l'armoire.* (The farmer's wife is carrying the cupboard.)
- L'infirmière porte la poire.* (The nurse is carrying the pear.)
- L'infirmière porte l'armoire.* (The nurse is carrying the cupboard.)

The sentence to identify was "*La fermière porte l'armoire.*" This was doubly difficult because "*La fermière*" and "*L'infirmière*" are very similar on the lips and so are "*l'armoire*" and "*la poire.*"

The total number of items was 78, consisting of equal numbers (26) for each condition of difficulty. Within the same condition, half of the items (13) were presented with lipreading alone (L), the other half with lipreading and cues (LC). The sequence of presentation of the different conditions of difficulty and of the L and LC items was randomized. To avoid any possible memory effect, each target sentence was only presented on one condition.

In order to avoid fatigue, the testing procedure was divided into two separate 20-minute sessions. The subject was fitted with his or her personal hearing aid(s) set at the most comfortable level, and was seated at a table in front of the video monitor, at a distance of one meter.

Before each test run, the experimenter explained to the subject the task to be performed and checked the good understanding of the instructions. Each test sequence started with three easy items, so that no training items were necessary to familiarize the children with the task and testing procedure.

## **Subjects**

All the subjects in this study had a prelinguistic hearing impairment. They were 24 children and youngsters, from 8 to 14 years old, attending the IS and the CCP, and 11 children, 5 to 10 years, 8 months old, who were consistently spoken to in CS by their parents at home.

The first 24 children, henceforth called the S (for school) group, had all except one been in the school for at least four years, during which CS had been used in the classroom and during the speech therapy sessions. It should, however, be mentioned that CS introduction in the school coincided with the beginning of the four-year period, and that the teachers and speech therapists were not familiar with the technique prior to its introduction. Most of them became totally fluent cuers after one or two years of practice, which means that the degree of consistent exposure of the children to CS was relatively reduced during that time. It was planned to test all the school children in the 8-to-14 age group. Since time did not allow this, the children to be tested were selected so as to include the widest range of variation in lipreading ability, spoken language achievements, and parental involvement in the educational process. Nearly all of them received CS only at school,

with only three mothers utilizing it also at home. The subjects' degree of hearing impairment, evaluated according to the IOAP<sup>2</sup> classification, was as follows:

- 1) mild auditory deficiency (20-40 d8 mean threshold of the better ear for 500, 1000, and 2000 Hz).
- 2) severe auditory deficiency (70-90 dB mean threshold).
- 3) profound auditory deficiency (greater than 90 dB mean threshold).

## Results

Tables 1 and 2 represent the mean number of correct responses per condition: lipreading alone (L) and lipreading plus cues (LC), and the degree of difficulty of the test items: easy (E), medium (M), and difficult (D), for each group of subjects: school (S-Table 1) and home (H-Table 2). The corresponding percentages of correct responses have been plotted in Figure 2.

**Table 1 Mean Number of Correct Responses & Corresponding Percentages for 24 S Subjects**

	Easy		Medium		Difficult		Total	
	(max.13)	%	(max.13)	%	(max.13)	%	(max.39)	%
L	11.00	84.61	7.92	60.90	4.79	36.86	23.33	59.83
LC	11.75	90.38	9.08	69.87	6.83	52.56	27.67	70.94
Gain	0.75	5.77	1.16	8.97	2.04	15.70	4.34	11.11

**Table 2 Mean Number of Correct Responses & the Corresponding Percentages for the 11 H Subjects**

	Easy		Medium		Difficult		Total	
	(max.13)	%	(max.13)	%	(max.13)	%	(max.39)	%
L	11.82	90.91	8.73	67.13	5.09	39.16	25.82	66.20
LC	12.91	99.30	11.18	86.01	9.36	72.03	33.45	85.78
Gain	1.09	8.39	2.45	18.88	4.27	32.87	7.63	19.58

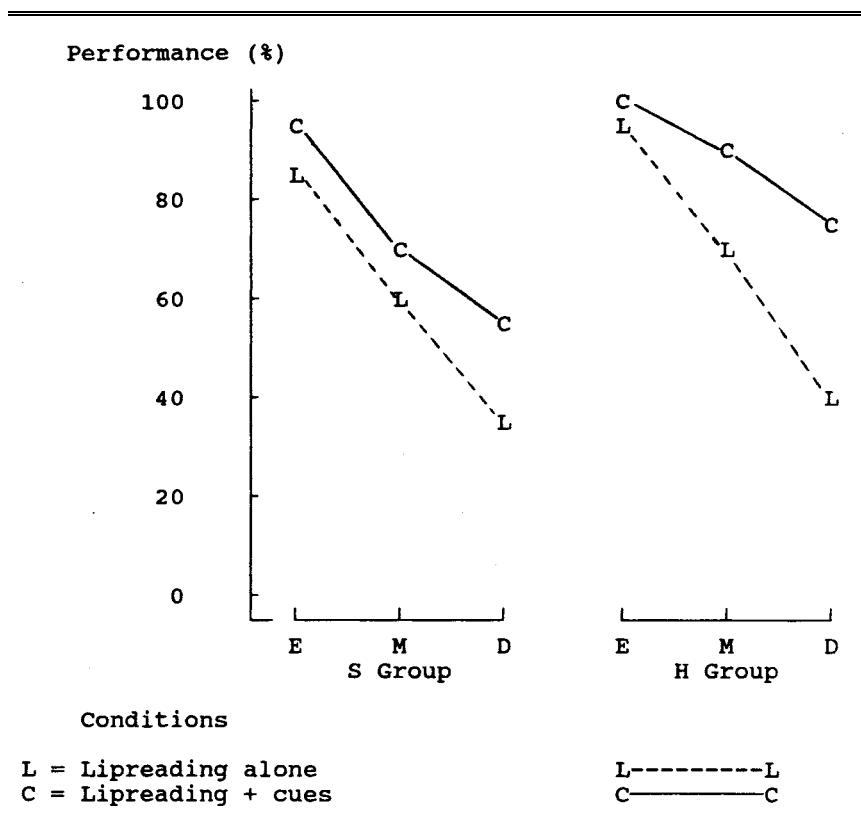
Visual inspection of the figure indicates that the degree of difficulty has a strong effect on the subjects' performance with scores not far from perfect for the E items and not very distant from the chance level (25%) for the D items when the lipreading alone condition is considered. No large differences between groups are noticeable in the lipreading alone (L) conditions, so that these curves can be considered as an adequate base level to interpret the effects of CS. When the cues are introduced, substantial improvements of performance appear. Not surprisingly, the effect of CS is greater in the difficult than in the easy condition in which the scores for lipreading are already almost perfect. Despite the fact that the effect of CS is clearly present in both groups, S and H, the subjects of the latter one seem to exploit the cues to a greater extent than those of the former one; they reach more than 70% of correct responses with the difficult sentences while the S group reaches only 52%.

The results have been submitted to a hierarchical analysis of the variance with subjects nested into two groups: S and H, factorially combined with conditions: L and LC, and degree of difficulty: E, M, and D. The global analysis shows that all of the main effects were significant:  $F(1,33) = 44.18, p = .0516$ ;  $F(1,33) = 65.35, p < .001$  and  $F(2,66) = 182.29, p < .001$ , for *groups*, *conditions*, and *difficulty* respectively. The conditions X difficulty interaction, not surprisingly, was also significant:  $F(2,66) = 6.00, p < .001$ . The critical interaction--groups X conditions X difficulty--reached a marginally significant value:  $F(5, 165) = 2.15, p = .0636$ , indicating that the effects of CS are probably greater in the H than in the S group.

In order to explore this question, as well as some others, in more detail, some partial analyses of the variance were made on the same data. The first consists of looking at the group effects in the lipreading alone condition only. No significant effect was obtained in the case:  $F(1,33) = 0.99$ , indicating that, as mentioned before, the groups are very similar in lipreading proficiency within the limits of the present work. The same analysis was performed on the LC data and in this case the group effect was rather important:  $F(1,33) = 7.73, p = .01$ . These results together strongly suggest that the groups X conditions X difficulty interaction in the global analysis, which was only marginally significant, reflects a genuine effect indeed.

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<sup>2</sup> International Office of Audiophonology or BIAP (Bureau International d'Audiophonologie)



**Figure 2 Performance as Related to Group and Condition**

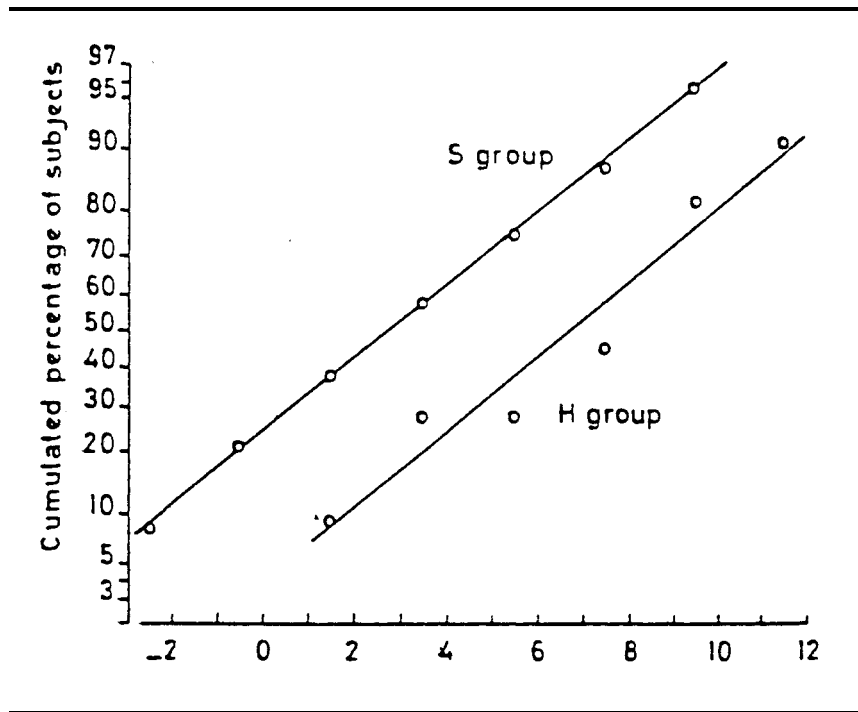
A third partial analysis was performed with the data obtained for the difficult items only. This was done because for the medium, and mainly for the easy items, the improvement from the L to the LC condition could have been influenced by ceiling problems. The results show a strong condition effect:  $F(1,33) = 29.94, p < .001$ ; as well as a clear group X condition interaction:  $F(1,33) = 4.52, p = .0442$ . This result confirms that H group improvements due to CS are greater than those of the S group.

Finally, a partial analysis was made of the data coming from the S group only, in order to ascertain that the CS effects obtained by this group were reliable. All the previous analysis are indeed compatible with the eventuality that group H is the only one to present CS effects. The results, however, show an important condition effect in the S group:  $F(1,23) = 24.49, p < .001$ .

Individual results of the subjects of the S group showed that some of them did not profit at all from the cues. Therefore, the possibility that this group consisted of two different subgroups, one being totally insensitive to CS, and the other as competent as the H group, could be considered.

In order to explore this hypothesis, the distribution of the individual improvement scores for the subjects of the S group was examined. For the sake of comparison, a similar analysis was made for the subjects of the H group. The cumulative distribution of the subjects' performance improvement, evaluated by their total percentage of correct responses in the LC condition minus the total percentage in the L condition has been represented in a PROBIT plot (Figure 3).

Figure 3 shows that the S group is homogeneously lower-performing than the H group, and there is no indication of a bimodal distribution in either one. In both groups, and particularly in the S group, the experimental points are very close to the mean squares' linear regression curves. The distribution of the improvement scores is, therefore, normal, as could be expected in a test involving a set of complex abilities rather than a particular one which could have been present in some subjects and absent in the others.



**Figure 3 Increase in the Number of Correct Responses from Condition L to Condition LC for the 39 Test Items.**

## Discussion

The first point of interest of this work was to verify whether LPC, the French version of Cued Speech, did improve the reception of spoken language, as has been demonstrated for the original English version (Nicholls, 1979; Nicholls & Ling, 1982). The results clearly show that it does. For the difficult items, the H group children's score in the LC condition was nearly double that in the L condition. The 72.03% correct results obtained may still seem not high enough, considering that the system is supposed to remove all the ambiguities of speechreading. It should be stressed, however, that the test items were constructed in such a fashion that no clues whatsoever were available from the context, a rare situation in natural spoken language. When the results of the three conditions (E, M, D) are pooled, a total of 85.78% is reached. This situation more closely approximates the one usually encountered in natural settings. Some differences do exist, however. The test situation is probably easier, inasmuch as the sentences were repeated and the choice limited to four possibilities. It was however, more difficult due to the absence of any contextual information. While the balance between these two opposite effects cannot be calculated, it seems justified to evaluate the reception possibilities for natural spoken language as being close to these 85.78%, or, at worst as lying somewhere between this figure and the 72.03% for the difficult items. In the S group, the amelioration afforded by the cues is smaller, and the reception scores of 52.56% for the D condition and of 70.94% for the pooled D, M, and E conditions are less remarkable. However, the gain over the lipreading alone condition (15.70% and 11.11% respectively) is not negligible, in view of the facts that the sample included children who were considered by their teachers and speech therapists as "non-receptive" to Cued Speech, and that small negative effects were even observed in some of them.

The second objective of the study was to shed some light upon the factors influencing proficiency. It can be seen from Figure 3 that this varies extensively within each group. This variation probably results from numerous factors related to individual differences between the members of each group, such as age, degree of hearing impairment, socioeconomic status of family, psychological adjustment, and intellectual capacity. These factors have not been taken into account in this phase of the study, so that no information can be gained from it concerning their possible incidence upon CS receptivity of individual children. The only factor which has been explored is the consistent utilization of CS at home for one group of children, compared to the others who were exposed to CS mostly at school. The results clearly show that this group factor was relevant for CS receptivity. It is worth noting, however, that in the present state of this work the school-home factor was confounded with the age at the beginning of CS exposure, most of the H group subjects having begun before those of the S group. It is, therefore, possible that the difference between the groups is at least partly due to this factor.

Another objective was to investigate whether exposure to CS modified current speechreading capacities without the cues. The data available from this work shows that the subjects of the H group, who derive the greatest benefit from CS,

have slightly though not significantly better results than the S group in the lipreading alone condition. Some parents and professionals have expressed the fear that consistent use of CS might induce dependency in subjects accustomed to benefit from it, with the result that speechreading without cues would then be adversely affected. The above data indicate that this fear, which was not shared by the present authors, is unjustified. Further investigations might compare the unaided performance of subjects who have acquired CS competence with that of similarly hearing-impaired children who have been mainstreamed and not exposed to CS. Such a study will be carried out, provided that sufficient numbers of comparable subjects can be made available.

The experimental procedure which has been described did not address the question of the possible utilization of phonological information brought by CS in reading and writing, which was a research objective. An experimental procedure consisting of "production" test, analyzing the cued response of children to written material, is in progress. It is hoped that it will supply some data about the latter question.

## Conclusion

Although still incomplete, this study has already brought forward some facts about CS utilization and efficiency. One of these facts, which has important bearing on educational practice, is that although all children in IS are exposed to CS, there are wide differences between them in the degree of benefit which they derive from it. For most of them, CS brings a substantial gain in spoken language reception. For some of the school children, however, no benefit was demonstrated by the testing procedure. Another important fact is that the greatest improvement in the reception of spoken language is achieved by those children whose parents utilize CS consistently at home. This observation confirms the validity of Cornett's customary answer to the question, "If one had to choose between CS at home or at school, which would be the most efficient?" His answer is that the best condition is when CS is consistently utilized in both situations, but that if only one were possible then it is CS at home which should be preferred. In the IS, consistent practice of CS has considerably modified and improved overall teaching practice, but has not resolved all difficulties, since part of the children do not, or do not yet, experience demonstrable benefit from its use. The results of the study will prompt an intensification of the efforts towards more active parental involvement in the consistent use of the method, while continuing to improve its utilization by the school and Center staff.

## Summary

The first results of a study still under progress were presented. The effects of Cued speech were studied in 35 hearing-impaired children. These consisted of two groups, of which one (N=24) had been exposed to CS mostly at school, the other (n=11) mostly at home. The ages ranged from 8 to 14 for the first group, and from 5 to 10.8 for the second one. The degrees of hearing impairment were, for the first group, one slight, two severe, and 21 profound; for the second group, three severe and 18 profound. The subjects were submitted to a videotaped reception test consisting of groups of sentences of three different degrees of difficulty, randomly presented with or without cues. The performances in the speechreading alone condition were slightly, but not significantly, better for the home group than for the school group. Both groups showed a significant improvement of their performance in the speechreading plus cues presentation. As expected this improvement was most obvious when the choice between the target sentence and other possibilities was most difficult. The improvement brought by the cues was significantly greater in the home group than in the school group. Further investigations will bear upon a larger group of subjects exposed to the same as well as to additional testing procedures.

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