Original Article

Persian Cued Speech: The Effect on the Perception of Persian Language Phonemes and Monosyllabic Words with and without Sound in Hearing Impaired Children

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Objectives: This paper studies the effect of Persian Cued Speech on the perception of Persian language phonemes and monosyllabic words with and without sound in hearing impaired children. Cued Speech is a sound based mode of communication for hearing impaired people that is comprised of a limited series of hand complements and the normal pattern of speech. And it is shown that it effectively can improve speech skills of hearing impaired children and adults. Cued Speech has recently been adapted to Persian language (1) and our knowledge about its efficiency is very limited.

Methods: Two groups of profoundly hearing impaired children participated in the study. They were matched with each other. The experimental group received an intensive Persian Cued Speech training program for several months. Prior to and following training and also three weeks after the sample's perception of Persian language phonemes and monosyllabic words were evaluated. Mixed Repeated Measurement was used to analyze the results.

Results: Findings indicated that experimental group's scores in both phonemes and monosyllabic words with and without sound were significantly difference between pre-test and post-test and follow up as a function of Cued Speech training ($p<0.0001$).

Conclusions: The results support the use of Persian Cued Speech for improving perception of Persian hearing impaired children to promote their communication performance.

Key words: Hearing impaired, Cued Speech, Monosyllabic words, Phonemes, Perception.

Introduction

Traditionally speech perception has been associated almost exclusively with audition. Mc Gurk and Mac Donald (1976) showed that this assumption was wrong, as sight does contribute to speech perception. Their findings have important implications for hearing impaired people, because visual speech constitutes the main speech modality (2). Hearing impaired children who have been orally educated typically rely heavily on lip-reading. On the other hand lip-reading has many limitations because without hearing the sounds, many syllables remain ambiguous due to their similar articulatory movements. For example labial consonants in /ma/, /pa/ and /ba/ or the lip rounding of vowels in /tu/ and /to/ cannot be differentiated. Only 40 to 60% of the vowels are recognized by the lip-reading system for a given language (American English). Thus understanding spoken language is difficult for many hearing impaired individuals (3, 4).

To overcome these deficiencies, several systems have been created aimed at disambiguating lip-reading by adding visual information carried out by the hands. The most current of them is Cued Speech. Cued Speech is a simple sound-based system of manual cues, cued in conjunction with spoken words which makes all the sounds of spoken language, fully comprehensible for hearing impaired people. When Dr. Cornett (1967) first invented Cued Speech, he set out to create a system, based on English phonemes (5, 6). Ever since then many people have worked to adapt Cued Speech (CS) to approximately 60 other languages and dialects which illustrates how useful Cued Speech is. Persian Cued Speech (1) is an example of Cued Speech being recently adapted to a language. Persian Cued Speech is not well known and Persian speaking communities are required to increase awareness of it, as well. Persian Cued Speech consists of nine hand shapes in three hand placements. Placements of

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the hand code vowels whereas hand shapes (or configurations) distinguish among the consonants. Fig .1 shows the adaptation of Cued Speech for Persian language.

A large amount of work has been devoted to the effectiveness of Cued Speech. Cued Speech allows access to complete phonological representations of speech (5) and language (7 & 8) and improves reading and writing performances in hearing impaired children, exactly like hearing children.

Cued Speech has significant effect on perception of phonemes both with and without sound, so it improves lip-reading as well (10). Nichols and Ling (1982) presented 18 profoundly hearing impaired children, with English syllables in seven conditions with auditory, lip-reading and cues presentations combined together. Under audition (A) alone, subjects correctly identify 2.3% syllables whereas scores in lip-reading (L), audition + lip-reading (AL), cues alone (C) and audition + cues (AC) reached 30-39% without significant differences. The scores with lip-reading + cues (LC) and audition + lip-reading + cues (ALC) reached 83.5% and 80.4%, respectively Mean scores for keywords were more than 90% in LC and ALC conditions (11). Kaplan (1974) studied the effect of Cued Speech on speech-reading performance of the prelingually hearing impaired individuals. The results showed that the presence of manual cues improved speech-reading scores for all types of materials (12). Chilson (1979) also showed that learning of Cued Speech significantly improved the speech reading skills of normal–hearing college students enrolled in phonetics courses (13). Uchanski *et al*., (1994) confirmed the effectiveness of Cued Speech for the identification of sentences with high or low predict performance. Subjects obtained mean scores varying from 78%to 97% with Cued Speech against 21% to 62% with lip-reading alone. French researchers showed that the subjects exposed early and intensively to Cued Speech were better lip-readers for the identification of words and pseudo words (14).

Cornett (1985), Kipila (1985), Hage, Alegria and Perier (1989) reported the effectiveness of Cued Speech on word perception. Several other studies indicate the efficiency of Cued Speech in several languages (15, 16, 17), but there is no evidence that shows Persian Cued Speech can have the same effect, because Persian phonetic differs from those languages; So the purpose of this study was to examine the effect of Persian Cued Speech on perception of Persian phonemes and monosyllabic words with and without sound (CS + lipreading vs CS + Audition + lipreading) in hearing impaired Iranian children. The goals were to examine whether Persian Cued Speech improves auditory perception and lip-reading of the nonsense syllables and mono–syllabic words or not and whether this effect sustains after the training.

Materials and Methods

Participants: Sixteen profoundly prelingually hearing impaired children (eight boys and eight girls), ages 9-12 years old were recruited in this study. Audiograms showed a pure tone average hearing loss of 90 dB or more for the better ear, according to the most recent available medical records. All participants studied in special schools for the hearing impaired in Tehran city. All were native speakers of Persian (Farsi) language and preferred an oral communication mode and had no other disabilities. The participants were matched with each other in IQ, age and sex so that we had two matched pair groups. Each group consists of eight children (four girls and four boys).

Instruments: Two tests were elaborated to achieve the goals of the study. The purpose of the materials selected was to ensure that the participants' responses were exclusively due to perception that is they were not deduced from the context. For this reason two tests were administered: Speech Discrimination Score Test (SDS) and Sara test (No.2). Both of the tests were administered individually for each participant.

SDS is one of the current routine tests in clinical audiology. We used one of SDS lists which consist of 25 monosyllabic words (the Persian version, 18). In order to examine the lip-reading performance of the participants, for monosyllabic words, the test was administered without sound. A female examiner read each word from the list without sound and without any exaggeration in lip patterns for each child. The child should then write whatever he/she understood on an experimental test page. The scoring was phonemic–the percent of correct phonemes not the whole word.

Sara test (19) is a lip-reading test which uses all the phonemes of Persian language in a simple A-phoneme-A context, so that the lip-reading performance of nonsense syllables can be examined. Errors are not simply counted rather the errors types are important. In fact groups of phonemes will be examined not just as a single consonant. For

example if a child mistakes /apa/ with /aba/ or /ama/, he/she will obtain 50% of the score. Because /p/, /b/ and /m/ are all bilabial and cannot be distinguished with lip-reading alone. The correct answer will obtain 100% of the score and 0% means the entirely incorrect answer.

Procedure: In this study we used a true experimental design, in which we had pre-test, post-test and follow-up with control group. Both of the experimental and control groups were tested three times, once before and twice after training. The groups were matched, so they were assumed equal. The dependent variables were examined in the same time and the same condition for both groups. Our study was administered in several stages.

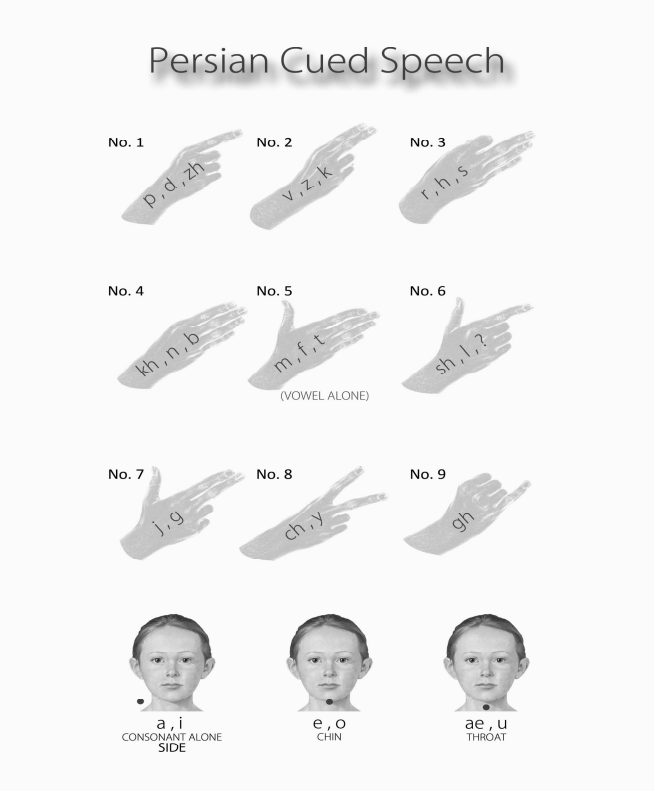
Pre-test stage:

All of the participants, the experimental and the control group underwent the examination through both tests.

Cued Speech Training: Training sessions for Persian Cued Speech were held for the experimental group. The experimental group was trained in a five-month training course, in individual sessions. The training course last five months and each of the children were taught 1-2 hours per day. In first sessions we reviewed the Persian phonemes to assure that the children know enough about the sounds that make up words. Because Cued Speech is a phonemic system, Cueing is relatively easy to learn; it requires about twenty hours to memorize the system at which point anything that can be spoken can be cued, albeit slowly. It is best to learn from an instructor in a face-to-face setting. Classes were offered in a room in the children's schools. It is much easier to follow a demonstration than read a wordy explanation, so we designed colorful cards each of them for a given hand shape. Learning to cue is like learning to take shorthand or to type. After the basic system is learned, regular practice is required to develop speed and fluency. One must, over time, develop the performance to automatically translate his/her internal representations for words as sounds into manual patterns. Surprisingly, the hardest part is identifying the sounds one actually produces when he speaks. Because we're more accustomed to dividing words into letters for spelling than into phonemes and this often leads us astray. Afterwards each hand shape was taught in several sessions so they became familiar with all of the hand shapes. In Persian language there are thirty two consonants, however only nine hand shapes are necessary to make each consonant visually distinct. We started with hand shape No.9 which represents for /gh/ which is a phoneme sound like /r/ in French language. We used it with vowels /a/ and /i/ which are produced in side placement-beside the face. Then hand shapes No.5, No 3, No.2.....were taught. Then the hand placements (vowels) were practiced.

In the last month, two syllabic words and then multi-syllabic words and sentences were introduced to the children.

Figure 1: Persian Cued Speech (Movallali, 2009)



Post-test Stage: Immediately after the completion of Cued Speech training, all of the participants, both experimental and control group were examined with SDS and Sara tests, in Cued Speech plus lip-reading condition.

Follow-up: One month later, both tests were repeated with and without sound for all of the children, with Cued Speech.

For statistical analysis, descriptive statistics were examined at first. Then to answer the study questions, we used mixed repeated measurements so that the effect of Cued Speech on phoneme and monosyllabic word perception of experimental and control group in pre-test, post-test and follow-up can be studied.

Results

In this study, we examined the effect of Persian Cued Speech on phoneme and monosyllabic words in Iranian profoundly hearing impaired children. The results are presented in two parts. In the first, we examined the results of the effect of Persian Cued Speech on the perception of Persian language phonemes (nonsense syllables) with and without sound. And secondly, we presented the effect of Persian Cued Speech on the perception of monosyllabic words.

A: Persian language phonemes (nonsense syllables), Sara Test

The results of within-subjects effects of Cued Speech on perception of phonemes showed that the amount of the obtained F (516.90) in perception of phonemes without sound and F (748.01) in perception of phonemes with sound in two groups (experimental and control group) was significant (α =0.01). It is obvious that there was significant difference in perception of phonemes both with and without sound in pre-test, post-test and follow-up stages between experimental and control group.

The between subject effects of Cued Speech on perception of phonemes results were F (3427.02) with sound and F (34830.18) without sound in two groups (experimental and control group). Therefore we can indicate that there is a significant difference (α =0.01) between perception of phonemes with and without sound in experimental and control groups. Therefore mean scores of the perception of phonemes with and without sound are higher than control group in post-test and follow-up. That is Cued Speech had improved the perception of phonemes with and without sound in experimental group. The effect size was 0.99 for phoneme perception with sound and 0.97 without sound that shows how great the effect of Cued Speech on phoneme perception is.

B. Perception of Monosyllabic Words (SDS Test)

The results of within-subjects effects of Cued Speech on perception of monosyllabic words with and without sound showed that the amount of the calculated F in monosyllabic words perception with sound (F=121.79) and without sound (F=87.81) in two groups (experimental and control group) were significant (P =0.01) and showed that there was significant difference in the perception of monosyllabic words with and without sound in pre-test, post-test and follow-up stages between experimental and control group.

The results of the between-subject effects of Cued Speech on perception of monosyllabic words showed that regarding the amount of calculated F with sound (F=9047.52) and with sound (F=8667.18) in perception of monosyllabic words in two groups (experimental and control group), it could be concluded that there was a significant difference (P =0.01) between perception of monosyllabic words with and without sound of the experimental and control group. Mean scores of perception of monosyllabic words with and without sound in experimental group were higher than control group, in post-test and follow-up. The Cued Speech had improved perception of experimental group for monosyllabic words both with and without sound. The effect size amount for monosyllabic perception with sound was 0.96 and monosyllabic perception without sound at 0.95, that showed the remarkable effect of Persian Cued Speech on perception of monosyllabic words.

Figure 2 shows the phoneme and monosyllabic word perception in four (1-Lipreading, 2-Lipreading + Audition 3-Cued Speech and Lipreading and 4-Audition + Cued Speech + Lipreading) in hearing impaired children. As it is shown Cued Speech improves the phoneme and monosyllabic word perception of the cases both with sound (audition) and without sound (lipreading)

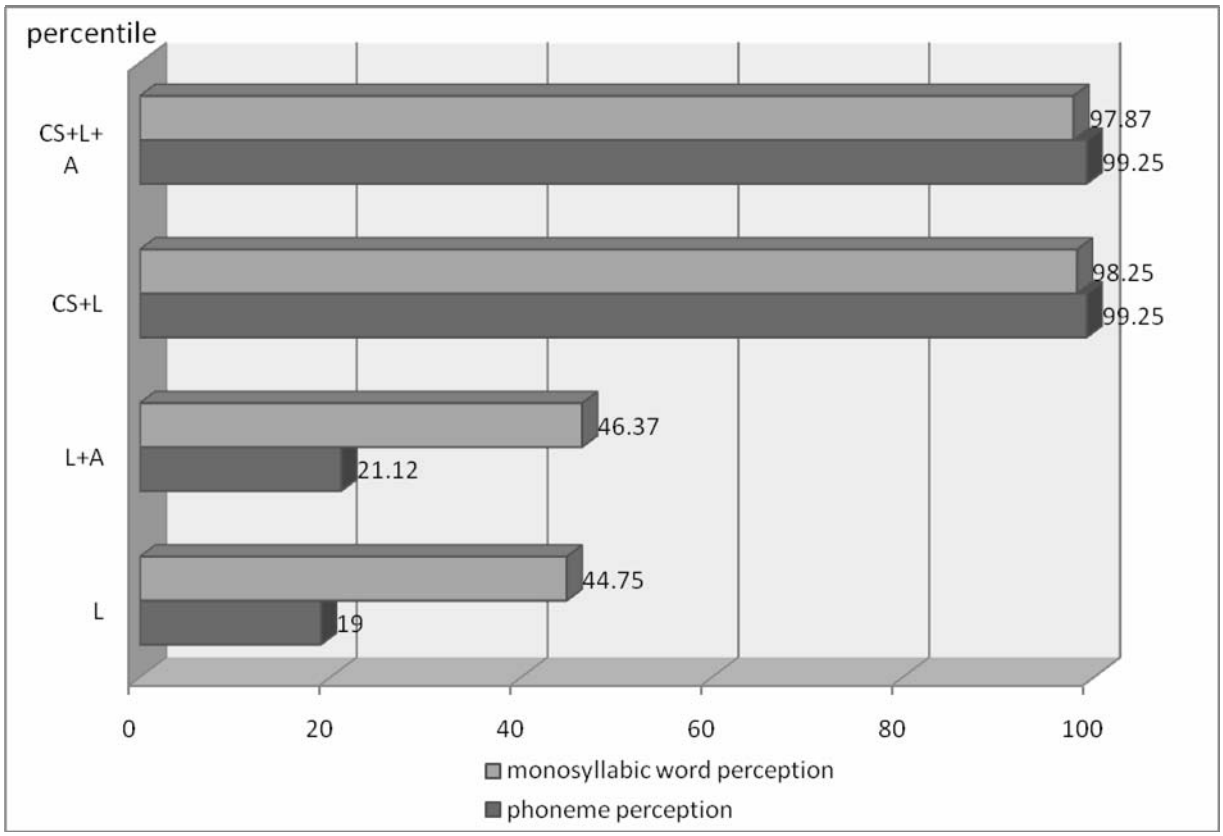


Figure 2: Phoneme and monosyllabic word perception in four conditions in hearing impaired children: 1-L (Lipreading), 2-L + A (Lipreading + Audition) 3-CS + L (Cued Speech and Lipreading) and 4- CS + L + A (Cued Speech + Lipreading + Audition)

The effects of Cued Speech on lip-reading performances were not related to the chronological age of hearing impaired children and there was no significant difference between boys and girls in lip-reading performance.

Discussion

These results regarding the effects of Cued Speech on deaf children's perception can be summarized in two points. First, and in consistency with some previous studies (11, 18), this study provides further empirical support for the notion that Cued Speech does enhance lip-reading performance (using speech materials without sound) effectively. Although most educators use the term lip-reading to mean the understanding of spoken language through its visible manifestations, and despite the importance of lip-reading for hearing impaired pupils, even with extensive training, most hearing impaired persons are inferior to the average hearing persons in ability to lip-reading without sound (5).

Second, we examined the effect of Cued Speech on speech perception of hearing impaired children in two areas, phonemes and monosyllabic words, and the effect was very astonishing: phonemes and monosyllabic words perception with and without sound was almost completed with cues.

The mean score obtained for the perception of phonemes (without sound) in experimental group increased from 19 (pre-test) to 99.52 (post-test) and 99.62 (follow-up) and for perception of phonemes with sound the mean score increased from 21.12 (pre-test) to 99.25 (post-test) and 99.62 (for follow-up). But the difference of mean scores in control group was not significant. So mean scores of phoneme perception with and without sound in experimental and control groups were significantly different. These results indicate that using Cued Speech, phoneme perception is almost completed. Previous studies gained such results too (20, 21).

The results pertaining the effect of Cued Speech on perception of monosyllabic words showed that there was a significant difference between word perception in experimental and control group both with and without sound in pre-test, post-test and follow-up. Assessments while the mean scores of control group remained almost the same from pre-test to post-test and follow-up, there was a

significant difference between mean scores of experimental group in pre-test (44.75), post-test (98.25) and follow-up (98.75) for monosyllabic words without sound and an increase from 46.37 (pre-test) to 97.87 (post-test) and 98.62 (follow-up) for monosyllabic words perception with sound. These findings again showed the strong effect of Cued Speech on perception of monosyllabic words in Persian language, which was in congruence with previous studies (12, 20). The results also indicate the great effect of Persian Cued Speech on lipreading and perception of phonemes and monosyllabic words do not show significant differences with and without sound. In the other word even if there is no sound, the perception is completed (because of lipreading). One possible explanation for the excessive improvement effect of Persian Cued Speech on lip-reading performance might be related to the Persian phonetics. We have no diphthongs and have only six vowels in Persian language so we use only three hand placements, each representing two vowels, thus Persian Cued Speech is much more easier to learn than Cued Speech in some other languages.

One of the study's limitations was that we could not examine long term effects of Persian Cued Speech on children's performances, because Persian Cued Speech is a very newly-introduced system in our country. Although lip-reading skill is desperately important to a hearing impaired person, yet it appears that only a few of them tend to become very good lip-readers. Prior knowledge of spoken language is probably the single important factor in becoming able to lip-read well. The prime function of Cued Speech during the early years is language development through easy and clear communication, therefore it seems reasonable to assume that children, who grow up on Cued Speech in the home, will often be skillful in speech perception and lip-reading (5, 22).

Conclusion

In sum, we can conclude that Persian Cued Speech strongly contributes to skill in lip-reading. It does improve the perception of phonemes and monosyllabic words and so can improve the hearing impaired children's overall language skills. Further researches are needed to examine long term effects.

References

1. Movallali G. Developing the Persian version of Cued speech and evaluation of its impact on speech perception of hearing impaired school age children .Unpublished Ph.D thesis, Faculty of Psychology, Tehran University, Tehran, IRAN,2009, [Persian].
2. McGurk H & MacDonald J. Hearing lips and seeing voices. Nature.1976; 264, 746-748.
3. LaSasso CJ, Crain KL, Leybaert J. Cued Speech and cued language for deaf and hard of hearing children , San Diego:Plural Publishing,Inc.2010.
4. Portolano M. Cued American English: a variety in the visual mode. Word Englishes.2008; 27, 2, 196-216.
5. Cornett RO and Daisey M. The Cued Speech resource book for parents of hearing impaired children (2nd ed.).Cleveland, OH: National Cued Speech Association. 2001.
6. Alegria J, Leybaert J, Charlier B, Hage C. On the origin of phonological representations in the hearing impaired: Hearing lips and hands .In: Alegria J, Holender D, Morais JJD, Radeau M.(Eds), 1992.Analytic Approaches to Human Cognition.Elsevier Science Publishers,Amsterdam,pp.107-132.
7. La Sasso C and Metzger M. An alternate route for preparing hearing impaired children for BiBi program: The home language as L.I. and Cued speech for conveying traditionally-spoken language. Journal of Hearing impaired Studies and Hearing impaired Education.1998;3,264-289.
8. Torres S, Moreno-Torres I, Sontana R. Quantitative and qualitative evaluation on linguistic input support to a prelingually deaf child with cued speech. A case study .J Deaf Stu Deaf Educ.2006;11(4):438-448.
9. Leybaert J. La lecture chez l'enfant sourd:l'apport du Langage Parle' Complete.Revue Francaise de Linguistique Appliquee. .,1996 ;1,81-94.
10. Neef NA and Iwata BA. The development of generative lipreading skills in hearing impaired persons using Cued Speech training, Analysis and Intervention in Developmental Disperformance, 1985; 5 , 4 , 289-305.
11. Nichols G, Ling D. Cued Speech and the Reception of Spoken Language, Journal of Speech and Hearing Research,1982;25,262-269.
12. Kaplan H. The Effect of Cued Speech on the Speech reading Performance of the Hearing impaired. Dissertation Abstracts International.1974.36, 2, 645B.
13. Chilson RF. Effects of Cued Speech on Lip-reading Performance. Unpublished master's thesis, University of Rhode Island. 1979.
14. Alegria J, Charlier B, Mattys S. The Effect of lip-reading and Cued Speech in the Processing of Phonological Information in French-educated Hearing impaired Children,European .Journal of Cognitive Psychology. 1999;11,4,451-472.
15. Cornett RO. Diagnostic factors bearing on the use of cued speech with hearing impaired children, Ear and Hearing, .1985;6,1,33-5.
16. Kipila B. Analysis of an oral language sample from prelingually deaf child's cued speech. Cued speech annual, 1985; 1, 46-59.
17. Hage C, Alegria J, Perier O. Cued Speech and language acquisition: The case of grammatical gender morpho-phonology. In Martin D (Ed.), Advances in cognition, education and hearing impairedness. Washington, DC:Gallaudet University Press. 1990.
18. Delfi M. Evaluation of speech discrimination scores (SDS) in normal hearing and noise induced high frequency hearing impaired workers of fulad company in Khuzestan ,Unpublished Master's dissertation .Iran Medical University. Tehran, IRAN, 2009, [Persian].
19. Movallali G, Biglarian A. Designing Sara Lipreading test (No2) and implementing it in a group of hearing adults, J

Reh 2003;4(13):53-58 [Persian]
20. Nicholls G. Cued Speech and the reception of spoken English. Unpublished Ph.D. Thesis , McGill University, Montreal , Canada. 1979,
21. Perrier O, Charlier B, Hage C, Alegria J. "Evaluation of the effects of prolonged cued Speech practice upon the perception of spoken language".1989. In I.G Taylor (Ed) "The education of hearing impaired: Current perspectives",1985;1, International Congress on education of the hearing impaired. Beckenham, Kent, UK: Croom Helm Ltd. (Reprinted in Cued Speech Journal, 1990; 4).
22. Montgomery AA, Jackson PL. Physical Characteristics of the Lips Underlying Vowel Lip-reading Performance, Journal of the Acoustical Society of America .1983; 73,6,2134-2144.