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Does Cued Speech Entail Speech?
An Analysis of Cued and Spoken Information in Terms of Distinctive Features

By Earl Fleetwood, M.A. and Melanie Metzger, Ph.D.

Abstract

The primary purpose of this study was to determine whether cued messages are products of a different set of distinctive features than are spoken messages. Toward that end, this study compares the linguistic information received by a control group of hearing native speakers of American English with the linguistic information received by a group of deaf native cuers of American English where such information is simultaneously spoken and cued to both groups. Some test material was designed to coincide linguistically across mode (i.e. spoken, cued). Some test material was designed to differ linguistically across mode.

As predicted, (a) responses were consistent within each group for all items tested, (b) responses were consistent across groups where simultaneously cued and spoken test material was designed to coincide linguistically across mode and, (c) responses differed across groups where simultaneously cued and spoken test material was designed to differ linguistically across mode. Because responses were group consistent for all test material, it can be said that each of the cued mode and the spoken mode are systematic and sufficient for conveying linguistic information. Because responses differed across modes for test items designed to differ linguistically across mode, it can be said that mode-specific attributes identify the linguistic value of a given message. Finally, and to the point of the current study question, because the value of particular linguistic

messages differed across groups even when group-internal agreement existed, it can be said that mode-specific attributes characteristic of speech are not entailed by the attributes that characterize cued messages.

Findings provide evidence that the distinctive features of speech are not phonetically relevant to receiving, processing, and comprehending cued messages. Findings leave open the possibility that acoustic (i.e., spoken) information that might accompany cueing could be used redundantly or confoundedly in receiving and comprehending linguistic information. Such a possibility is analogous to that of the function and influence of visual information as used by the hearing speakers of a given language: the information is neither primary nor compulsory in nature. Findings help to distinguish between the systematic or definitional requisites of cueing and the variables characteristic of those who send (e.g., some speak while cueing) and receive (e.g., hearing acuity varies) cued messages.

Findings support the use of cueing with and by deaf individuals who (a) do not acquire language primarily through hearing and/or (b) who do not primarily use speech to communicate language. Findings also support the use of cueing with deaf individuals who use at least some hearing and/or speech to acquire and/or communicate language.

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Cued Speech (Cornett, 1967) is an articulatory system[1] designed to support the development of literacy skills in individuals who are deaf/hard-of-hearing. "The development of Cued Speech came about specifically because of concern over the fact that deaf children do not typically learn to read well" (Cornett & Daisey, 2001, p. **256**).

The role of Cued Speech in the development of literacy skills is based on the notion that it conveys all of the linguistic structures of a traditionally spoken language beginning at the phonemic level. By design, Cued Speech uses hand shapes paired with mouth shapes to represent consonant phonemes and hand placements paired with mouth shapes to represent vowel phonemes. These visible representations of the phoneme stream provide for the formation of syllables and words and subsequently carry the grammar of a given consonant-vowel language.

Cued Speech is designed with the idea that through sufficient exposure to a language that is cued in natural interaction, individuals who are deaf or hard-of-hearing will acquire the phonology, morphology, and syntax of that language. Because natural language acquisition occurs passively through consistent exposure to natural language use, it would follow that deaf/hard-of-hearing cuers need not consciously ponder this phonologic, morphologic, and syntactic information any more than do individuals who use signed languages and spoken languages. Practically speaking, exposure to a *cued language*[2] used in natural interaction serves

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[1] Cued Speech has most commonly been described as a system of communication that is both visible and acoustic in nature. It was first described by Fleetwood and Metzger as a visible articulatory system (Fleetwood & Metzger, 1991). See Fleetwood and Metzger 1998 for an in depth discussion of Cued Speech as a visible articulatory system.

[2] cued language: (noun) a class of consonant-vowel languages rendered via the employent of articulators, including non-manual signals (found on the mouth), hand shapes, and hand

as a linguistic avenue for (a) gaining world knowledge, (b) learning how that language is used in face-to-face interaction, and (c) subconsciously acquiring the phonologic, morphologic, and syntactic structures of that language.

The deaf/hard-of-hearing individual who internalizes the phonology of a cued language, such as cued American English, can apply that information to the process of reading. Orthographic representation of consonant-vowel phonology (i.e., written characters of the alphabet) can be correlated with the internalized cued phonologic representations. The deaf/hard-of-hearing individual can then become an autonomous reader, utilizing phonologic word attack strategies to decode written words (Alegría, Lechat, & Leybaert, 1988; Leybaert, 1993), and world knowledge, gained through language used in natural interaction, to understand what is read.

Evidence that cueing has positive effects on literacy development has been found in numerous studies (see Leybaert & Charlier, 1996 for a review). For example, Leybaert (1998) suggests that deaf native cuers develop phonological representations of a given language comparable to hearing native speakers of that language. In fact, Cued Speech appears to provide linguistic information sufficient for deaf cuers to develop literacy skills on a par with hearing speakers of that language (Alegría, Dejean, Capouillez, & Leybaert, 1990; Alegría et al. 1988; Leybaert & Charlier, 1996; Wandell, 1989).

Unfortunately, discussion in the literature has left the distinction between phonetic and phonemic information ambiguous where the functional requisites of cueing are concerned. As a result, attributes that serve to define the nature of cued input have been neither clearly nor

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placements (i.e., cuem), that are modulated in conjunction with other non-manual information, such as head and eyebrow movements, to convey phonemic, (or tonemic), morphemic, syntactic, semantic, and pragmatic information in the visible medium; a member of this class of languages consistently characterized. This is particularly significant when it comes to identifying the distinctive features that comprise cued phonological segments. Because, speaking and cueing are so phonetically and phonemically intertwined in the literature, questions remain about the necessity of speech knowledge and speech production skills in the production, reception, perception, and processing of cued messages. Because the nature of phonologic segments is foundational in a linguistic sense, answers to such questions have significance with regard to both how cueing functions modally and with whom it can best be used.

The issue of language modality has received increasing attention in recent years. After several decades of finding evidence that signed languages are as linguistically legitimate as spoken ones, researchers have begun to turn their attention toward the unique distinctions between languages commonly found in the visual mode and languages commonly found in the acoustic mode (see, for example, Hildebrandt and Corina, 2000 and Channon 2000 regarding phonology, Mathur 2000 and Wood and Wilbur 2000 regarding morphology, McBurney 2000 and Pfau 2000 regarding syntax, and Grote 2000 regarding modality effects on the mental lexicon, and Lucas and Valli 1992, Lucas et al 2001 regarding sociolinguistic variation).

Research and discussion have also contributed to a better of understanding of the distinction between modality, communication systems, and language. For example, some have examined the impact of manually-coded English signing systems on the acquisition of English grammar (at least morphologically and syntactically) through the signed modality (see Bellugi, Fischer, & Newkirk, 1979; Davidson, Newport, & Supalla, 1996; Kluwin, 1981; Marmor & Petitto, 1979; Maxwell, 1983, 1987; Schick & Moeller, 1992; Stack, 1996; Supalla, 1990,1991). Others have examined attempts to convey English grammar (phonologically, morphologically, and syntactically) through the cued modality, with cued languages such as cued English and cued

French (cf Fleetwood & Metzger, 1991, 1998; LaSasso & Metzger, 1998). Recent literature also specifically compares and contrasts the cued modality with the spoken one (cf Fleetwood & Metzger, 1998; Leybaert, 1993; Leybaert & Charlier, 1996; Leybaert, 1998; Leybaert, Alegria, Hage, & Charlier, 1998).

Such lines of study consistently indicate that the mode of communication does have an impact on the efficacy of the associated method of communication. For example, even when manually-coded English sign systems serve as primary input to deaf children and youth, their signed output is more likely to incorporate the reduplication convention of natural signed languages to encode the notion of "plural" than to use the affixation convention of English (Supalla, 1991). Additional distinctions can be found at the phonological, morphological, and syntactic levels of linguistic structure. Thus, the visual-spatial modality encodes information about English differently than that encoded in the acoustic mode.

Conversely, a case has been made that Cued Speech is able to visually encode information about languages that are traditionally conveyed acoustically. Research (Hage, Alegria, & Périer, 1990; Kipila, 1985; Metzger, 1994; Mohay, 1983; Moseley, Williams-Scott, & Anthony, 1991; Nash, 1973) provides evidence that deaf children consistently exposed to a cued language from an early age naturally acquire salient phonologic, morphologic, and syntactic features of that language. Those same features consistently elude deaf children who grow up signing a natural language, a signed system, or who are raised with oral methods (see Leybaert, 1998; and Leybaert & Charlier, 1996 for overviews of this discussion as it pertains to literacy development). Nevertheless, in research and discussions about Cued Speech, confusion seems to persist regarding the mode of communication.

Cued Speech as it is described and defined in the literature is a bimodal system, visible and acoustic by nature. In light of findings regarding the relationship between auditory and visual information in hearing people, the notion of using information in multiple channels is not surprising (see Summerfield, 1987 and Schwartz, Robert-Ribes, & Escudier, 1998 for an overview of audio-visual fusion and speech perception). However, the quantity and quality of the acoustic information perceived by deaf individuals is not as predictable or controllable. Thus, a question for the current study is, 'Is acoustic information necessary to the efficacy of cueing a language?'

The question of whether Cued Speech functions as a bimodal system, as a visual system with optional acoustic redundancy, or simply as a visual system is an interesting theoretical issue. Perhaps more importantly it is also a practical one. Practically speaking, the notion that Cued Speech functions as a bimodal system is fundamental to perceptions and resulting decisions regarding the linguistic and communicative competence of deaf cuers. This becomes clear where, for instance, Perigoe and LeBlanc (1994) discuss the development of speech production in "the hearing-impaired child." Toward this end they say, "One must concentrate on making the spoken language output of the hearing-impaired child as clear as his/her spoken language input" (p. 30). A fundamental assumption entailed by their statement is that the child's linguistic input is via access to a *spoken* language and, hence, the articulation of speech. One purpose of the current study is to examine the validity of that assumption. Is it accurate to conclude that *spoken* language is the form of input carried by a cued message? If it is not, then perhaps "the spoken language output of the hearing-impaired child" *is* in fact "as clear as his/her spoken language input."

The term *spoken* is the operative consideration here. Perhaps a reason that a deaf cuer might be found in speech therapy is that Cued Speech does not provide *spoken* language input.

Maybe the reason "it is difficult to tell a child he is incorrect when expressively both his language and cues may be perfect" (Perigoe & LeBlanc, 1994, p. 31) is because the child's output is, in reality, a "perfect" reflection of his/her input. Perhaps it is not the child who is "incorrect" but, instead, the accuracy of definitions against which his/her performance are being measured. This notion is addressed by the current study.

Other discussions of Cued Speech are also based on the idea that it conveys *spoken* language. According to Daisey (1987), Cued Speech provides "an internalized speech-coding system and enables a deaf child to have spoken English--that is, syllabic-phonemic English--as his native language" (p. 27). This statement reflects inconsistency with regard to what Cued Speech codes: Does it code speech (e.g., phonetic attributes) or does it code phonemes (i.e., mental values)? To state the latter is to say that Cued Speech presents a structural aspect of a given language: phonemes. This notion is at least indirectly addressed by the current study. To conclude the former, however, is to propose that Cued Speech represents the distinctive articulatory features of speech. A fundamental purpose of the present study is to determine whether cued messages are products of a different set of distinctive features than are spoken messages.

Many discussions about cueing are conducted with the perspective that Cued Speech is a speechreading supplement: "Cues are added to the natural mouth movements of speech" (Daisey, 1987, p.17); "[Cued Speech] is a phonemically-based hand supplement to speechreading" (Caldwell, 1994, p. 58); "[Cued Speech is] a system for support of speechreading" (Cornett, 1967, p. 6); "In English [Cued Speech] utilizes eight hand shapes, placed in four different locations near the face, to supplement what is seen on the mouth" (Cornett & Daisey, 2001, p. 17). Common to these discussions is the idea that "what is seen on the mouth" is not discrete in and of itself. However, such discussions seem to overlook the idea that the hand shapes and hand placements of Cued Speech also are not discrete in and of themselves. According to Cornett, "Phonemes alike on the mouth are different on the hand, and vice versa" (Beaupré, 1984, p. iv). A paraphrase of "and vice versa" might read: 'Phonemes alike on the hand are different on the mouth.' Thus, it would seem that Cued Speech is no more a system for supplementing speechreading than it is a system for supplementing hand shape and hand placement reading. Because information found on the mouth in the course of cueing is assumed to be processed by the deaf native cuer as a distinctive feature of speech, one question addressed by the current study is with regard to the nature of "what is seen on the mouth." Specifically, if speaking and cueing are presented simultaneously, does a deaf native cuer process the information on the mouth as part of the articulatory system known as *speech*, or does a deaf native cuer utilize "what is seen on the mouth" as a feature of a different articulatory system?

It is interesting to note that one assumption entailed in the "supplement to speechreading" perspective is that the ability to speak is requisite of the person who is cueing. In other words, without the ability to speak, the cuer cannot, by definition, produce speech information for the message receiver to "read." If the information presented is not the product of speech, then it cannot accurately be said that the message processed by the receiver is even in part a product of "speechreading."

It is also interesting to note that if the quality of a cuer's speech production impacts the quality of cued messages, hearing native speakers who cue would more likely be competent cuers than would deaf *native* cuers. This counterintutive notion is supported by longstanding speech-based definitions and descriptions of Cued Speech.

Since its invention, various definitions and descriptions of Cued Speech have included reference to speech, speechreading, and/or sound. Even the name of the system suggests that speech production is fundamental to the integrity of cued messages. In fact, the National Cued Speech Association's (NCSA) Board of Directors states "Reference to Cued Speech should never be made in such a way as to imply that the process of cueing equates with C[ued] S[peech]. In other words, CS in its complete form includes both cueing and speaking" (National Cued Speech Association Board of Directors, 1994, p.69). (Although not underlined in the adopted wording, references to speech, speechreading, and/or sound have been underlined in order to highlight them.)

In defining Cued Speech, the NCSA Board of Directors makes the following assertions:

> A definition of Cued Speech, in order to describe it accurately and to distinguish it from all other systems developed for the benefit of hearing-impaired persons, must include at least the three basic ideas in the following statement: Cued Speech is a communication system which (1) utilizes hand configurations (eight in English) in locations (four in English) near the mouth, (2) to supplement the normal visual manifestations of speech (3) in such a way as to render the spoken language clear through vision alone " (National Cued Speech Association Board of Directors, 1994, p.70).

The website of the National Cued Speech Association puts forth the following description: "Cued Speech is a sound-based visual communication system which, in English, uses eight hand shapes in four different locations ('cues') in combination with the natural mouth movements of speech, to make all the sounds of spoken language look different." (Retrieved March 16, 2002 from **http://www.cuedspeech.org**)

It is unclear whether these definitions are written in terms of what hearing native English speakers think they are conveying when they cue or whether the definitions are written in terms of what it is thought that deaf native English cuers are receiving. Nevertheless, if it is found that a cued English message can differ from a spoken English message when cueing and speaking occur simultaneously, it becomes at least questionable whether speech, speechreading, and/or sound are a part of the way Cued Speech conveys information. It also brings into question whether speech, speechreading, and/or sound are an accurate part of describing how Cued Speech works.

In sum, the literature states and/or suggests that individuals who send cued messages and individuals who receive them must possess and employ knowledge of spoken language, speech production, and/or speechreading as part of the communication process. Reasons for such statements, suggestions, and assumptions might include the following rationale:

1. The production and comprehension of cued information like the production and comprehension of spoken information involves use of the mouth.
2. Cued phonemic referents and spoken phonemic referents can coincide with regard to their linguistic values.
3. Speakers may cue while they talk and cuers may talk while they cue.
4. The system itself is called “Cued Speech.”

The current study tests whether this rationale equates with the assumption that cued information entails speech sounds or renders representations of speech sounds. Perhaps it does neither. Implicit and previously untested, the aforementioned assumption has significant implications for the methodological choices and/or the conclusions that have been drawn from empirical research. This is true for studies that have examined the effect of Cued Speech on deaf children's speech reception (such as Chilson, 1985; Clark & Ling, 1976; Kaplan, 1974; Ling & Clark, 1975; Neef, 1979; Nicholls-Musgrove, 1985; Perrier, Charlier, Hage, & Alegría, 1987; Sneed, 1972; Nicholls, 1979; Nicholls & Ling 1982; Quenin 1992), those that have focused on how cueing affects deaf children's speech production (including Ryalls, Auger, & Hage 1994), and those that have studied cueing as it relates to language acquisition (such as Cornett, 1973; Mohay, 1983; Nash, 1973; Mosley, Williams-Scott, & Anthony, 1991; Kipila, 1985; Metzger, 1994).[3]

Regarding speech production in cuers, Ryalls et al. (1994) examine some phonetic attributes of speech in an effort to determine how they might be manifest in the spoken utterances of deaf cuers who use speech as a means of communication. This study is one of the first and few to examine the question of whether the phonological effects of cueing also have phonetic implications for speech production. Their research question is based on the notion that "Cued Speech does succeed in delivering more complete information on speech contrasts" (Ryalls, et al., 1994, p. 8). They raise the question of the relationship between phonological input and output, addressing whether the cued input that affects "speech reception" also improves speech production. Specifically, they examined voice onset time, syllable duration, and fundamental frequency in the speech of deaf cuers as compared with deaf non-cuers and hearing children.

Ryalls, et al. (1994) found statistically significant differences only between the non-cuers and the hearing groups. The cueing group clearly matched neither the non-cuers nor the hearing

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[3] These studies have been reviewed in detail in previous editions of this journal. See, for example, Leybaert & Charlier, 1996; LaSasso & Metzger, 1998)

group, but fell between the two. The authors suggest that additional data, particularly with older cuers, is warranted by their study.

In light of the current study, it is significant that Ryals, et al. (1994) implicitly assume as part of their conclusions that access to cued messages (a) provides deaf cuers exposure to the phonetic attributes of speech (acoustic information rather than visible articulatory information from the cueing) and (b) that the speech of a deaf cuer is the product of such exposure. For example, Ryalls et al. (1994) say it is “obvious that a better internal concept of voiced and voiceless phonemes would naturally lead to a better distinction in production” (p. 16). However, the authors (a) do not distinguish between the deaf cuer’s knowledge of phonemic and phonetic values, (b) do not explain how the visible attributes of cueing provide for a better internal concept of an acoustically manifest feature, and (c) do not control for the influence of speech therapy on knowledge of phonetic aspects of speech production.

The implicit assumption that cueing entails and subsequently conveys features of speech production does not allow for the possibility that the visible articulators used when cueing (i.e., hand shape, hand placement, and mouth formation) might in fact produce their own set of distinctive features. In other words, such an assumption discounts the possibility that a visibly accessible phonetic distinction between the phonemes /k/ and /g/ for deaf cuers might be the presence or absence of the thumb extension [± thumb] rather than presence or absence of voicing (Fleetwood & Metzger, 1998). It is simply an extension of this assumption for previous studies to conclude that demonstrating positive relationships between the reception of a cued language and phonological awareness relevant to literacy skills equates with demonstrating knowledge of and/or skills with the distinctive features of speech.

Ryalls et al.’s (1994) study is actually founded on assumptions made in earlier studies of cuers. For example, Nicholls (1979) and Nicholls and Ling (1982) studied the speech reception abilities of 18 profoundly deaf children under the following conditions: audition; lipreading; audition plus lipreading; cues; audition plus cues; lipreading plus cues; and audition, lipreading, plus cues. Nicholls (1979) and Nicholls and Ling (1982) found that in the lipreading plus cues condition as well as in the audition, lipreading, plus cues condition participants scored over 95% for key words in sentences and over 80% with syllables.

An underlying premise of these studies is that they are testing participants' ability to "receive speech under seven conditions of presentation" (Nicholls & Ling, 1982, p. 265). "Cues plus lips" is characterized as one condition of speech presentation. In that condition, Nicholls (1979), and Nicholls and Ling (1982) find no statistically significant difference between the reception of linguistic information with or without audition. Subsequently, the authors conclude that "a strong correlation exists between speech perception, speech production, and linguistic skills" (Nicholls, 1979, p. 83) and that participants "receive highly accurate information on the speech signal" (Nicholls & Ling, 1982, p. 268)

In light of these conclusions, it is significant that the authors did not attempt to dissociate linguistic information in the acoustic and visible modes. In other words, the opportunity to distinguish between the features that constitute speech perception and/or production and those that constitute linguistic values and linguistic processing is not provided by the experimental design. Because the values rendered simultaneously in each modality coincided linguistically, the authors' conclusion that "simultaneous use of two modalities enhances speech reception" (Nicholls, 1979, p. 83) actually rests on their implicit and untested assumption that cues plus lips are received and processed as a condition of speech.

In another study, Quenin (1992) finds a positive correlation between Cued Speech and the tracking performance of deaf college students who cue. "Results indicated that the reception of connected speech was considerably more efficient with cues than without" (Quenin, 1992, p. 82). In this study, three deaf cuers were exposed to the speech and speech plus cues of different speakers reading texts of two different complexities (6th-grade and 10th-grade passages, as calculated by at least five common estimation methods for determining reading level). Although there was some variance across participants and over time, all three participants did perform better in the cued conditions than in the uncued conditions, for both levels of text.

In Quenin's study, the linguistic value of a given test item was established in deference to information found in the acoustic mode. Quenin applies the term "connected speech" to the information generated in that mode. She also applies the term to the visible by-products of the articulation of speech.

By design, participants did not access information via the acoustic mode, "remov[ing] their hearing aids in all conditions so that speech was received visually only" (Quenin, 1992, p. 54). Participants assigned linguistic value to the information that they received. The linguistic values identified by participants in the cued condition coincided with the linguistic value of test items generated in the acoustic mode.

This is evidence that the acoustic mode and the visual mode can carry information of coinciding linguistic value. However, Quenin subsequently concludes that participants are using cues as enhancements to the visible products of speech production (e.g., connected speech). In this regard, Quenin has actually tested for one thing — coinciding linguistic value — and concluded another — entailed articulatory value. Thus, evidence about one condition is used to assert an untested prima facie claim. Determining whether the former need derive from the latter tests the integrity of this claim and is fundamental to the current study.

What are the implications of this prima facie claim? Quenin's conclusion relies on an implicit assumption for which she neither tests nor controls. Specifically, in Quenin's study, the visible articulatory by-products of connected speech were never accompanied by cues (i.e., hand shapes and hand placements) that might result in responses linguistically different from those prompted solely by acoustic information resulting from "connected speech." In other words, Quenin does not segregate cueing and speaking in either an articulatory sense or a linguistic one. Had she done so and had linguistic values differed along modal lines, perhaps Quenin would not have found evidence that cues support connected *speech*. Instead, perhaps she would have found evidence of connected *cueing*. At least she would have had the opportunity to determine whether connected speech and connected cueing are complete and segregated types of connected discourse.

Each of the aforementioned studies is an example of research that reflects implicit and significant assumptions about the relationship between cued information and spoken information. Each makes the assumption (a) that the processing of visual, cued input is inherently integrated with the processing of acoustic, spoken utterances, (b) that Cued Speech is perceived as supplementary to an existing articulatory system (i.e., speech) rather than that Cued Speech functions as an articulatory system in and of itself, and (c) that information on the hand (i.e., "cues") functions as a feature of one set of articulators while information on the mouth functions as a feature of another (i.e., speech).

When describing the nature of a cued message, the aforementioned studies also do not differentiate the role of residual or aided hearing as supplementary, redundant, or as simply cooccurring. For example, Nicholls (1979) and Nicholls and Ling (1982) point out that the ceiling effects in their study between the two conditions, lipreading plus cues with audition, and lipreading plus cues without audition, prevent them from drawing any conclusions regarding the significance of the auditory signal when cueing. They point out that both profoundly deaf and hard of hearing individuals find themselves in situations where noise level and/or distance prevent the use of residual or aided hearing. That is, they make the point that it is visual information, rather than acoustic information, that is critical to both deaf and hard of hearing people. They suggest that future research test the question of the relationship between the acoustic and visual signals.

The studies mentioned above provide evidence that native users of cued English receive and perceive the same linguistic information when exposed to the same cued English utterances. Some of these studies also affirm that native users of spoken English receive and perceive the same linguistic information when exposed to the same spoken English utterances. Group-consistent responses suggest that the articulatory input that each group receives is systematic. That is, deaf cuers who participated in the studies perceive the phonemic, morphemic, and syntactic information that constitutes their particular cued language (e.g., American English, Australian English, Mandarin Chinese). Some questions that have not been tested are: While each cued language utilizes a system of phonemic referents (i.e., allophones), do these referents entail either the phonetic features or the allophones of the counterpart spoken language (e.g., American English, Australian English, Mandarin Chinese)? Are cued allophones characterized by a different bundle of features than are spoken allophones targeting the same phonemes? These questions drive the current study.

Purpose of Study

The purpose of this study was to determine whether Cued Speech entails speech. By the design of Cued Speech, the mouth is employed in the production of cued allophones. The mouth is also employed in the production of spoken allophones. Perhaps this fact that cueing and speaking employ the mouth in the production of allophones (phonemic referents) is what feeds the prevailing assumption that cueing employs and/or conveys speech. No doubt, bolstering this assumption are findings that deaf native cuers of a language recall the same linguistic information as hearing native speakers of a language when both are exposed to simultaneously cued and spoken information. A question that has not been tested is to what degree, if any, are the features of speech production required of and responsible for coinciding linguistic values simultaneously produced in the spoken (acoustic) and cued (visible) modes.

Even if information on the mouth of a deaf native cuer and the mouth of a hearing native speaker coincides, linguistically relevant contrast can still exist with regard to the simultaneous production of cued and spoken phonemic referents (allophones). That is, although it probably never occurs intentionally in natural interaction, one can employ the hand shapes and hand placements necessary to produce the cued English word *talk* and simultaneously employ the voice, manner of articulation, and place of articulation that produce the spoken English word *dog*. For each word, simultaneously cued and spoken, the mouth shapes would coincide. By presenting deaf and hearing participants with this type of linguistically dissociated stimuli, one could examine the assumption that the distinctive features that define the articulation of speech are somehow entailed in the production and reception of cued information.

Cueing one linguistic message while speaking another is not general practice among the members of cueing communities. Nevertheless, experimentally providing this type of stimuli allows an opportunity to determine the salient features of cueing and, subsequently, the relationship, if any, between Cued Speech and speech. Findings have both theoretical and practical implications in the areas of language development, phonological awareness, and literacy development. Potentially, findings of the current study impact the interpretation of some previous findings, characterizations, and descriptions related to Cued Speech.

Theoretically, the ways in which systems of communication are processed by human beings is of interest to psychologists and linguists, and to those investigating communication and speech perception. Practically, gaining a better understanding of the relationship between Cued Speech use and spoken language knowledge can provide useful information regarding who is a viable candidate for using a cued language, whether or not a cuer must have some measure of hearing or some prior knowledge of a language, and ultimately, how cued languages might be applied in bilingual or multilingual contexts, educational curriculums, literacy learning, speech therapy, and other settings. For these reasons, the question presented for investigation is, 'Does Cued Speech entail speech?'

Methods

Participants

Twenty-six participants were included in this study. Thirteen were prelingually deaf, sighted[4] native[5] cuers of American English, including 8 females and 5 males ranging between 16

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[4] For purposes of the current study, it is assumed that sighted, hearing native speakers have seen the mouth movements that accompany speech. Consequently, sighted, hearing people have the opportunity to formulate relationships between a mouth shape that is seen and a speech sound that is heard. In contrast, and for the purpose of this experiment, it is assumed that by virtue of being deaf, sighted deaf individuals do not access the sounds of speech with the same degree of acuity as do hearing individuals. Thus, while sighted deaf native cuers have experience 1) seeing mouth shapes as one aspect of a cued message and 2) seeing the mouth shapes used in the production of spoken messages, they do not have the opportunities afforded sighted hearing

and 30 years of age. The mean age at which these deaf individuals began using English in the cued mode is 4:4. A hearing control group consisted of 13 hearing, sighted native speakers of American English, including 7 females, and 6 males between the ages of 18 and 32. The mean age at which these hearing individuals began speaking English is 0:8. All hearing participants reported that speaking was the primary mode and English the primary language used by their parents and in school.

Of the deaf participants, 10 reported profound losses, 1 reported a severe to profound loss, and 2 reported severe losses. Ten indicated that they were deaf at birth. Three reported that onset of deafness occurred prior to age 18 months. Ten deaf participants indicated that they received English via the cued mode prior to age 3. Two indicated that their initial exposure to cued English was age 5. One participant reported first exposure to cued English beginning at age

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individuals with regard to formulating relationships between a mouth shape that is seen and a speech sound that is heard. This distinction between sighted deaf and sighted hearing individuals is a fundamental consideration in determining at least some of the criteria that governed the determination of eligible participants.

[5] For purposes of the current study, the term *native* is defined in consideration of (a) language (e.g., English), (b) mode (e.g., cued or spoken), (c) number of years exposed to a given mode and language, and (d) cultural/community involvement.

The deaf participants for this study all had been cueing American English since their early years at school, and for at least half of their lives. Hearing individuals who began using English in the spoken mode no later than their early years at school and who has used spoken English for more than half of his/her life is also considered *native* for this study. The mean age at which the hearing individuals began using English in the spoken mode is 0:8.

Consideration of language and mode is clearly necessary for this study, since it focuses on the accessibility of each. Consideration of cultural and community involvement is emphasized by Roy (1986). She found that a variety of language experts, including linguists, sociolinguists, and anthropologists, agree that language users one might define as native (those whose performance is viable for research purposes) are typically those individuals who interact within a community of users. Thus, the fourth criteria was that participants be active members in the deaf cueing community, as evidenced by interaction with other cuers in the home, socially, and at community events such as family cue camps.

8. Twelve deaf participants reported that initial exposure to English via the cued mode was from at least one parent. One reported initial exposure at school, followed by cueing from at least one parent at home. In the educational setting, cueing was the primary mode and English the primary language beginning in preschool for 10 participants, starting in first grade for 2 participants, and beginning in fourth grade for 1 participant.

In order to better control for the effects of access to both cued and spoken information, hearing native speakers who had no knowledge of cueing were chosen as the control group; while they could fully access the cued information, they had not developed the ability to process it. For the purposes of the current study, this condition is considered analogous to that of deaf native cuers who might have some experience with sound, but who do not have the acoustic acuity by which the spoken information would be sufficiently accessible to them acoustically. Hence, they would not have the opportunity to process the spoken information. The hearing control group consisted of 13 hearing, sighted native speakers of American English, including 7 females, and 6 males between the ages of 18 and 32. The mean age at which these hearing individuals began speaking English is 0:8.

Test Material

In order to address the relevant study question a videotape was produced. By design, videotaped material contained both linguistically dissociated and linguistically associated stimuli conveyed via simultaneously cued and spoken test items. Specifically, the videotape contained both cued and spoken representations of isolated phonemes, isolated words, and short phrases. These stimuli were presented in two different conditions: (a) the associated condition, in which the cued and spoken messages coincided linguistically, and (b) the dissociated condition, in which the cued and spoken messages did not coincide linguistically.

For both conditions, and because each of cueing and speaking utilize the mouth toward the rendering of linguistic information, test items were chosen such that the mouth could be simultaneously employed in the rendering of both visible (cued) and acoustic (spoken) information (e.g., spoken *talk* and cued *dog*). Test items were selected with the goal that 50% of the simultaneously cued and spoken information not coincide linguistically (designated as the *N* test items) and that 50% of said information would coincide linguistically (designated as the *C* test items).

Participants were provided two trials in each condition, although they were not aware of this. In their first trial, deaf participants were provided visible, cued (i.e., hand shapes, hand placements, and mouth shapes) messages only. In their first trial, a hearing control group was provided acoustic (i.e. sounds of speech) messages only. In the second trial both the deaf and the hearing participants were provided both the cued and the spoken messages (i.e., both the visual and acoustic modes). As directed by written instruction, participants used written English to record the information that they received from the stimuli. A hearing control group native to spoken English was provided the same two conditions.

For each test item, it is predicted that the hearing control group will respond in keeping with values ascribed to acoustic distinctive features produced by speaking, as described by example below. For each test item, it is predicted that the group of deaf cuers will respond irrespective of speech production or speech products. Those responses will instead reflect values ascribed to distinctive features produced by cueing, also described by example below.

The design of the current study provides for cross-modal linguistic dissociation while maintaining mode-internal production constraints. So, in terms of how cued allophones and spoken allophones are produced, mouth shape coincides across modes for co-presented test items. Thus, test stimuli are never dissociated mode-internally. Theoretically, this allows a cued allophone of /p/ and a spoken allophone of /m/ to co-occur. Mouth shape should not cause any unexpected responses from the hearing group since mouth shape coincides with the production of both the spoken and the cued utterances. The hand cues themselves should be meaningless to participants in the hearing control group, since none of them knows a cued language or even Cued Speech.

By design of the current study, it is hypothesized that a given *N* test item will elicit, for example, the written response *p* from each of the deaf native English cuers and the written response *m* from each of the hearing native English speakers (see figure 1). This prediction is based on how allophones are rendered via cueing and how they are rendered via speaking. For example, where the value /p/ is represented in the cued mode, the visible allophone consists of a hand shape that, by itself, represents any of /d/,/p/, /zÍ/ a simultaneously produced mouth shape that, by itself, represents any of /m/, /b/, /p/. Resulting from the intersection of the specific hand shape and mouth shape is a discrete visible symbol that serves to discriminate among these five possibilities. That visible symbol is a cued allophone of /p/ (see Figure 1). By design of the current study, an acoustic symbol yielding a spoken allophone of /m/ is co-presented in the spoken mode as a bilabial, voiced, nasal, continuant.

Also by design of the current study, it is predicted that a given *C* test item will elicit, for example, the written response *v* from all respondents in both groups of participants. Like the *N* test items, this prediction is based on the manner in which allophones are rendered via cueing and via speaking. For example, where the value /v/ is represented in the cued mode, the visible allophone consists of a specific hand shape that, by itself, represents any of /k/, /v/, /∂/, or /z/ and a simultaneously produced specific mouth shape that, by itself, represents either /v/ or /f/. Resulting from the intersection of the specific hand shape and mouth shape is a discrete visible symbol that serves to discriminate among these five possibilities. That visible symbol is a cued allophone of /v/ (see Figure 1). By design of the current study, an acoustic symbol yielding a

SAMPLE *N* TEST ITEM

The cued allophone seen in the photograph above and the spoken allophone [m] are rendered simultaneously. It is predicted that the written responses of deaf native English cuers will be *p* and that the written responses of hearing native English speakers will be *m*.

SAMPLE *C* TEST ITEM

The cued allophone seen in the photograph above and the spoken allophone [v] are rendered simultaneously. It is predicted that the written responses of deaf native English cuers will be *v* and that the written responses of hearing native English speakers also will be *v*.

Figure 1

spoken allophone of /v/ is co-presented in the spoken mode as a labiodental, voiced, fricative.

For the *N* test items, where a cued allophone of /p/ and a spoken allophone of /m/ are co-presented, a written response of *m* would indicate that the products of speech are primary or overriding where decision making about linguistic values is concerned. If the written response *p* were recorded, this would serve as evidence that the features and products of speech are not relevant to linguistic decision making.

The *C* test items do not allow for this distinction. For example, where a cued allophone of /v/ and a spoken allophone of /v/ are co-presented, a written response of *v* by the deaf participants would *not* serve as evidence that the features and/or products of speech production are relevant to them. This is because recognizing a cued allophone of /v/ is predicted as sufficient for providing a written response of *v*. Previous research has only tested this condition in which the linguistic value of messages rendered in both modes is intended to be the same.

For both the *N* and the *C* test items, it is predicted that the hearing control group will respond in keeping with values ascribed to a bundle of acoustic features produced by speaking, irrespective of cuem production or cuem products. For each test item it is predicted that the group of deaf cuers will respond in keeping with values ascribed a bundle of visible features produced by cueing, irrespective of speech production or speech products.

The issue of the participants' visual and acoustic access to the test items is central to the validity of the current study. As pointed out by numerous researchers, audio-visual information may share a common metric (Summerfield, 1987; Schwartz et al., 1998), and anyone receiving access to both heard and seen information may fuse the two (see, for example, McGurk, & MacDonald, 1976). Any data collected without controlling for visual and acoustic access would leave as ambiguous any conclusion regarding whether the distinctive features of cueing and the distinctive features of speaking differ or are one and the same. Thus, unless the test participants are provided access to both the cued (visible) and the spoken (acoustic) test items, the current study cannot effectively distinguish between whether responses are the result of attributes of the articulatory system accessed by the participants or whether the responses are simply the products of accessibility constraints.

Controlling for access has implications with regard to several study-related questions including: (a) Do the distinctive features of speech (i.e., voice, manner, and place) constitute or are they part of the articulatory system (i.e., Cued Speech) through which deaf native cuers send and receive linguistic information? (b) When provided the opportunity to simultaneously access cued and spoken information, do deaf native cuers defer to the products of an articulatory system not defined by the distinctive features of speech? (c) If an articulatory system other than speech drives the linguistic perceptions of deaf native cuers, are these decisions so driven even when speech is co-presented? The current study directly addresses question (a) above. However, in light of questions (b) and (c), the validity of the study's findings is dependent on controlling for the participants' access to the test items.

Items appearing in the list of Cued test items were co-presented with items appearing in the list of *Spoken* test items. For example, *Cued* test item #3 and *Spoken* test item #3 were simultaneously rendered (see Table 1). *Cued* test items were selected strictly with regard for their visible attributes (e.g., hand shape, mouth shape). *Spoken* test items were selected strictly with regard for their acoustic attributes (e.g., ± voice). Both the *N* test items and the *C* test items were selected with regard for these considerations. All test items matched in terms of mouth shape, regardless of whether they coincided linguistically. The stimuli were divided according to both length and condition. That is, the progression of stimuli moved from representation of isolated phonemes to isolated words and then to phrases. In each of these groupings the first five were *N* test items followed by five *C* test items. Test items were presented in the sequence shown in Table 1. All participants provided written responses.

— CUED — Linguistic Items Presented via the Visible Features of Cuem	TEST ITEM	**— SPOKEN —** Linguistic Items Presented via the Acoustic Features of Speech
/g/	1	/k/
/p/	2	/m/
/i/	3	/I/
/d/	4	/n/
/u/	5	/ú/
/k/	6	/k/
/m/	7	/m/
/I/	8	/I/
/n/	9	/n/
/ú/	10	/ú/
/trènd/	11	/drèd/
/píg/	12	/bik/
/tänz/	13	/däz/
/dríp/	14	/trím/
/pèt/	15	/mèn/
/drèd/	16	/drèd/
/bik/	17	/bik/
/däz/	18	/däz/
/trím/	19	/trím/
/mèn/	20	/mèn/
/ít kúd hæpën/	21	/íts ë gúd hæbít/
/hi gävénd ∂ä kí˜Ñdëm/	22	/ít kävéz ∂ä híltap/
/lèts bi kërir fokëst/	23	/lènd mi yé írz foks/
/pè-í ëtènsÍën/	24	/mè-ík ë dänjÍën/
/a-í told yu ∂e-íd käm/	25	/a-í dont cÍu ∂æt gäm/
/a-í pè-íd for ínsÍéíns/	26	/a-í mèt ë forín jÍÍénëlíst/
/íts ë gúd hæbít/	27	/íts ë gúd hæbít/
/ít kävéz ∂ä híltap/	28	/ít kävéz ∂ä híltap/
/lènd mi yé írz foks/	29	/lènd mi yé írz foks/
/mè-ík ë dänjÍën/	30	/mè-ík ë dänjÍën/
/a-í dont cÍu ∂æt gäm/	31	/a-í dont cÍu ∂æt gäm/
/a-í mèt ë forín jÍÍénëlíst/	32	/a-í mèt ë forín jÍÍénëlíst/

TABLE 1

For the purpose of this study, the visible attributes of *Cued* test items were defined in the following terms: an isolated cued English allophone is considered the product of (1) the simultaneous pairing of a particular mouth formation with a particular hand shape (at any of 4 specific placements) to represent a specific consonant phoneme or (2) the simultaneous pairing of a particular mouth formation with a particular hand placement (with any of 8 specific hand shapes) to represent a specific vowel phoneme. Articulators that produce a cued phonemic referent are assumed to be visible. It is assumed that visual access to the articulators of cueing constitutes access to a phonemic referent (cued allophone) produced by the articulators of cuem. These assumptions are used as the basis for predicting the responses of the deaf native English cuers to both the *N* and the *C* test items. As part of this study, the efficacy of these assumptions was determined by whether or not actual responses coincided with predicted responses. See Appendix A to view a single cued allophone[6] for each phonemic value in American English.

For the purposes of this study, the acoustic attributes of *Spoken* test items were defined in the following terms: an isolated spoken English allophone was considered the product of employing a mouth, teeth, tongue, throat, and soft-palate formation through which exhaled air is channeled and which is simultaneously voiced or non-voiced. The articulators that produce a spoken allophone were assumed to be not completely visible. The exhalation of air was assumed to be not completely visible. The channeling of air was assumed to be not completely visible. Whether the referent is voiced or non-voiced was assumed to be not visible. It was assumed that visual access to the articulators of speaking does not constitute access to an allophone produced

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[6] Allophones are symbols that (a) are generated by a set of articulators and (b) function as referents to phonemic values. The features that constitute a given allophone are articulator-specific. Because cueing includes articulators that are not used to produce speech, cued allophones are defined by a different set of features than are spoken allophones, even if cueing and speaking co-occur. As with spoken allophones, the number and nature of cued allophones is driven by the rendering of a given language by the given set of articulators. Appendix A illustrates only one possible cued allophone for each of the phonemes of American English.

by the articulators of speech. Simple put, it was assumed that the sounds generated by speech production cannot be seen. These assumptions are used as the basis for predicting the responses of the hearing native English speakers to both the *N* and the *C* test items. Again, as part of this study, the efficacy of these assumptions was to be determined by whether or not actual responses coincide with predicted responses.

During a pre-study review of the testing material, flaws were noted in cued test items numbered 23 and 25; unintended hand shapes and/or hand placements were articulated. This is likely a cognitive manifestation of producing mismatched cued-spoken information; the cuer who presented the test items does not regularly strive to simultaneously generate two different linguistic messages. While participants were exposed to the flawed test items, the test items are not included in the results and analysis portions of the current study as they do not satisfy the test material parameters.

Procedure

A VHS recording was prepared in advance of the experiment. The VHS videotape contained a simultaneously recorded visual and audio track. The video track consisted of visual (cued) information, specifically the cued representation of isolated phonemes, isolated words, and short sentences. The audio track consisted of acoustic (spoken) information, specifically the spoken representation of isolated phonemes, isolated words, and short phrases. Participants were exposed twice to the same videotaped test items. The participants were not told that the same test items would be used in both trials. The participants' first trial was exclusively via his/her native mode of communication (i.e., cued/visual). Participants who used assistive listening devices as a part of regular life routines continued to use them for both trials in this study.

If members of either group were given access to the other's native mode of communication (i.e., speech or cuem[7]), it would be unclear whether written responses were products of (a) the distinctive features of cueing, (b) the distinctive features of speech, or (c) a mixture of the distinctive features of cueing and of speaking. By eliminating sound from the test items received by deaf native cuers, the acoustic features of speech were removed as a consideration with regard to what prompted their written responses. By eliminating the video image from the test items received by hearing native speakers, the visible features of cuem were removed as a consideration with regard to what prompted their written responses. Because the cued and the spoken test items were co-presented, a comparison of the responses of each group--the deaf native cuers and the hearing native speakers--can be revealing with regard to (a) whether or not speech and cuem exist autonomously, (b) whether the distinctive features of speech and of cuem differ or are one and the same, and (c) whether the distinctive features of speech and of cuem can exist independently yet co-occur. Thus, initial exposure to the test stimuli was provided exclusively via the native mode of a given test subject.

During the deaf participants' first trial, the television monitor was adjusted such that the video image could be seen to the satisfaction of participants. Additionally, during the deaf

[7] In order to more easily refer to the visible features of Cued Speech independently of the speech, speechreading, and/or sound references and assumptions found in traditional definitions, discussions, and most research, Fleetwood and Metzger (1998) use the term *cuem* (hand cues + mouth formations) to refer to the strictly visible phenomenon. This phenomenon is characterized by the coordinated manipulation of articulators, including hand shapes, hand placements, and non-manual signals found on the mouth, used to visibly render the phonology, and subsequently the morphology and syntax, of approximately 60 of the world's major languages and dialects. The term *cuem* is used to clearly differentiate between the articulators of spoken messages (e.g., lips, teeth, tongue: speech) and the articulators of cued messages (e.g., hand shapes, placements, and mouth formations: cuem) under investigation.

participants' first trial, the volume on the television monitor was set to zero (no sound).

During the hearing control group's first trial, the volume on the television monitor was adjusted such that the sound track of the video recording matched the decibel level that the participants were using in pre-test conversation. Additionally, during the hearing participants' first trial, the picture on television monitor was dimmed completely.

Each participant was also provided a second trial with the same test stimuli. The second trial co-presented spoken and cued test items. This was done to determine whether or not participants who are native to the distinctive features of a particular mode (i.e., speech or cuem) are influenced by the distinctive features of their non-native mode, should the distinctive features of one mode prove to be different than the distinctive features of the other. Without providing simultaneous exposure to both the spoken and the cued test items, the results of the current study would be subject to scrutiny on the grounds that test items should not both systematically segregate features into two pre-determined sets, then conclude that participants naturally defer to these sets. Thus, the second trial allowed participants to determine to which distinctive features they deferred.

During the deaf participants' second trial, the volume on the television monitor was adjusted such that the sound track of the video recording matched the decibel level that the hearing control group used in pre-test conversation. Deaf participants who make use of residual hearing and/or assistive listening devices had the opportunity to make use of same. The television monitor was adjusted such that the video image could be seen to the satisfaction of participants.

During the hearing control groups' second trial, the television monitor was adjusted such that the characteristics of the video image matched what the deaf participants had seen. The volume on the television monitor was adjusted such that the sound track of the video recording matched the decibel level that the hearing participants were using in pre-test conversation.

Both groups of participants were exposed twice to 16 stimulus items, each exposure constituting a trial. The end of the first trial and the beginning of the second trial were unmarked. Participants were told that the stimuli contained 32 items. Specifically, participants were directed via a blank answer sheet numbered from 1-32 as per the following written[8] English instructions: "Using the video/audio recording as a source, for each number below, write the information that you receive."

The purpose of providing two trials was to conduct both intra- and inter-group comparisons. Such comparisons provided evidence for determining whether or not spoken (acoustic) information impacted on the responses of deaf native English cuers. Although not a question for the current study, it also provided evidence of whether cued (visual) information impacted on the responses of the hearing, native English-speaking control group.

It is at least worth noting that controlling for *access* to a given participant's non-native mode was not possible. Both sighted deaf and sighted hearing individuals have complete access to the products of cueing (e.g., visible symbols) and, thus, to the visible features of cuem. However, sighted deaf individuals do not have complete access to the acoustic features of speech; the acoustic symbols produced by speaking are not visible. Thus, despite attempts to provide equivalent controls for exposure to the non-native mode, such equivalency is, at best,

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[8] Collecting data in written form confined the responses of all participants to a common medium. As a result, spoken responses of the hearing control group were not measured against cued responses of the group of deaf cuers. Additionally, the skills required to transcribe data were not subject to the transcriber's competence, or lack thereof, in the reception of cued or spoken information. Hand written responses originating with the participants, and the deciphering thereof, sufficiently allowed for collection of data relevant to the study question while helping to limit possible error resulting from mis-comprehending the data.

random with regard to the deaf participants' second trial. Fortunately, the first trial provided the controls necessary to determine whether or not cueing entails the distinctive features of speaking. The second trial was simply an attempt to discover to which set of distinctive features the two groups of participants deferred when both visible and acoustic features were co-presented.

Test stimuli were presented by a 35 year old, female, hearing native speaker of American English. The presenter had 20 years of experience communicating language via the visual mode, including functioning as a signed language interpreter (interpreting between American Sign Language and spoken English) certified by the Registry of Interpreters for the Deaf, Inc.; as a cued language transliterator (transliterating between cued and spoken English) certified by the Testing, Evaluation, and Certification Unit, Inc.; as a cued language transliterator educator teaching graduate and undergraduate courses; and as a professor of signed language interpretation in a graduate program. The presenter made no errors on the Basic Cued Speech Proficiency Rating (Beaupré, 1983), a standardized test that evaluates knowledge and skills with regard to cueing mechanics.

Results

Participants in the hearing, native English speaking control group recorded the same responses for both trials (see Table 2). Given that the only difference between the trials was the addition of the video-image, it appears that the rendering of cued information did not affect their linguistic judgments. This provides evidence that hearing native users of spoken English who have not previously seen or studied cueing do not consider the articulatory features of cuem when making linguistic decisions. This was true of the hearing control group with regard to their phonemic, morphemic, and syntactic decisions (see Table 2). This provides evidence that visible articulatory features of Cued Speech (i.e., hand shape, hand placement, and mouth formation) are not entailed by speech.

It is not surprising that the linguistic decisions of hearing participants appeared unaffected by the presence of hand shapes and hand placements; no member of the hearing control group had experience with cueing. It is also not surprising that the mouth shapes serving as one feature of the cued stimuli did not confound the hearing participants' predicted responses to the spoken stimuli. Even when linguistic values for co-presented test items did not match, the mouth shapes coincided with what is likely the hearing participants' experience with seeing speech while hearing it produced (for reviews, see Summerfield, 1987; Massaro, 1987).

The fact that the hearing participants consistently provided predicted responses to the acoustic stimuli presented in the absence of the video image is an interesting result. Where mouth shape is not accessible, one could expect that spoken allophones representing isolated phonemes such as /m/ might instead be perceived as spoken allophones of isolated phonemes such as /n/ (cite). The fact that this did not occur simply suggests that although visual

	Deaf Participants' Predicted Responses	Percentage of Actual Responses Corresponding with Predicted Responses for Deaf Native Cuers of English		Test Item	Percentage of Actual Responses Corresponding with Predicted Responses for Hearing Native Speakers of English		Hearing Participants' Predicted Responses
		1st Trial (n=13)	2nd Trial (n=13)		1st Trial (n=13)	2nd Trial (n=13)	
N Test Items	"g"	100	100	1	100	100	"k", "c"
	"p"	100	100	2	100	100	"m"
	any of: "ee", "eee", "e′", "ea"	100	100	3	100	100	"i"
	"d"	100	100	4	100	100	"n"
	any of: "ue", "ooo", "o′o′′"	100	100	5	100	100	any of: "oo", "oÃoÃ"
C Test Items	"k", "c"	100	100	6	100	100	"k", "c"
	"m"	100	100	7	100	100	"m"
	"i"	100	100	8	100	100	"i"
	"n"	100	100	9	100	100	"n"
	any of: "oo", "oÃoÃ"	100	100	10	100	100	any of: "oo", "oÃoÃ"
N Test Items	"trend"	100	100	11	100	100	"dread"
	"pig"	100	100	12	100	100	"beak"
	"tons"	100	100	13	100	100	"does"
	"drip"	100	100	14	100	100	"trim"
	"pet"	100	100	15	100	100	"men"
C Test Items	"dread"	100	100	16	100	100	"dread"
	"beak"	100	100	17	100	100	"beak"
	"does"	100	100	18	100	100	"does"
	"trim"	100	100	19	100	100	"trim"
	"men"	100	100	20	100	100	"men"
N Test Items	"it could happen"	100	100	21	100	100	"it's a good habit"
	"he governed the kingdom"	100	100	22	100	100	"it covers the hilltop"
	"let's be career focused"	N/A	N/A	23	N/A	N/A	"lend me your ears folks"
	"pay attention"	100	100	24	100	100	"make a dungeon"
	"I told you I'd come"	N/A	N/A	25	N/A	N/A	"I don't chew that gum"
	"I paid for insurance"	100	100	26	100	100	"I met a foreign journalist"
C Test Items	"it's a good habit"	100	100	27	100	100	"it's a good habit"
	"it covers the hilltop"	100	100	28	100	100	"it covers the hilltop"
	"lend me your ears folks"	100	100	29	100	100	"lend me your ears folks"
	"make a dungeon"	100	100	30	100	100	"make a dungeon"
	"I don't chew that gum"	100	100	31	100	100	"I don't chew that gum"
	"I met a foreign journalist"	100	100	32	100	100	"I met a foreign journalist"

Table 2

information might be used when available, it is not a requirement for the reception of spoken language, at least not for the given test items as provided the hearing control group in this study.

Deaf native users of cued English recorded the same responses for their first and second trials (see Table 2). Given that the only difference between stimuli in the second trial was the addition of the sound-track information, it can be said that for the deaf participants the inclusion of spoken information was linguistically unnecessary with regard to the rendering and/ comprehension of cued information. This was true regardless of their hearing acuity. Because deaf participants provided responses in keeping with a different set of features than those yielding messages in the acoustic mode for the *N* test items, it appears that the articulatory features of speech are not salient to linguistic decision making by deaf native English cuers. This is true with regard to their phonemic, morphemic, and syntactic decisions. This provides evidence that the acoustic articulatory features that constitute speech are not entailed by Cued Speech. Such evidence is significant as it is counter to the previously described implicit assumption that Cued Speech entails articulatory features and/or products of speech.

Although no interviews with the participants were conducted, two of the deaf native cuers made comments via cued American English as they departed the test site. They expressed the belief that the acoustic information provided in the second trial influenced, and even changed, their judgments about what had been cued. Given that deaf native cuers provided the same written responses in the first trial as they did in the second trial, the test data do not bear out the aforementioned belief held by these two deaf participants; the deaf native cuers did not defer to acoustic information when making linguistic judgments.

Perhaps any acoustic information that a deaf participant might have received was accessible to the degree that it served a redundant and secondary function. For example, if the deaf participants could hear the number of syllables rendered in the spoken test items (e.g., two syllables in the spoken word *hilltop*) perhaps they used this information as a confirmation of the number of syllables they had seen cued (e.g., two syllables cued in the co-presented word *kingdom*). If the number of syllables did not coincide (e.g., cued the four syllable phrase *for insurance* while speaking the five syllable phrase *foreign journalist*), perhaps this went unnoticed or perhaps the visual (i.e., cued) information was simply prioritized over the acoustic (i.e., spoken) information in linguistic decision making. Whatever the sense of these two deaf participants when co-presented cued and spoken test items, the written responses of all the deaf participants not only suggest that they do not make linguistic judgments as products of acoustic (i.e., spoken) information, the data suggests that they do not make linguistic judgments as a product of the visible articulators of speech. What the deaf native cuers could see of the articulation of speech did not necessarily elicit the same linguistic responses as did what the hearing native speakers could hear of the speech articulation products.

Where all other participants provided one set of responses to the test material, one deaf native cuer provided two sets of responses to selected items: one set was provided in response to the first trial, and two sets were provided in response to the second trial. For each test item found in the second trial — the exposure that included acoustic information — this deaf native cuer provided two responses, writing "cued" next to one written response and "spoken" next to a second written response for a given test item. At first glance, it appears that this deaf native cuer was able to simultaneously receive and process visible (i.e., cued) and acoustic (i.e., spoken) information and separate them in terms of their linguistic values.

It is noteworthy, however, that this deaf native cuer's written responses to the second trial seem to assume that all of the test items were, in effect, *N* test items (i.e., cued-spoken mismatches); while this participant might have differentiated what was seen from what was heard with regard to the actual *N* test items, it is possible that this participant's mismatch-responses for the *C* test items are simply products of patterns he/she noted in his/her mismatch-responses to the actual *N* (i.e., dissociated) test items. Regardless, as with all of the other deaf native cuers, all of this participant's responses to the cued test items coincided with the predicted responses for those test items. This test subject's seeming ability to simultaneously process and recall two distinct messages (for the *N* test items) provides information consistent with other data collected in the current study and serves as unique evidence in terms of addressing the focus of this study.

Responses of the deaf native cuers coincided with responses of the hearing native speakers for the *C* test items. However, responses of the deaf native cuers did not coincide with those of the hearing native speakers for the *N* test items. The former finding suggests that the linguistic values rendered via the articulators of cuem can coincide with the linguistic values rendered via the articulators of speech. However, the latter finding suggests that this linguistic correlation is not the product of a coinciding articulatory system. Reconciling this with the earlier finding that deaf native English cuers do not consider the articulatory features of speech when making linguistic decisions, it appears that cueing and speaking work autonomously in rendering linguistic values. Apparently, any linguistic correlation between cueing and speaking is an option rather than a requirement. Regardless of whether a simultaneously cued and spoken message can yield information of equivalent linguistic value, results of the current study suggest that the salient articulatory features of Cued Speech are functionally distinct from those of speech.

The result of presenting visual and acoustic mismatches to sighted hearing participants has been noted by McGurk and MacDonald (1976). The McGurk Effect refers to the finding that simultaneous exposure to both the visual and the acoustic channels can create a condition unique to either channel exclusively. The McGurk Effect suggests that sighted, hearing people who are presented information simultaneously in two channels are affected by the information originating in both channels in terms of what they receive, perceive, and process.

While simultaneous cueing and speaking also presents information in two channels, the current study finds no evidence of the McGurk Effect where participants are sighted deaf individuals. The sighted deaf participants provided responses consistent with information found in the visual channel regardless of the presence of information in the acoustic channel. In light of the McGurk Effect, this suggests that while simultaneous cueing and speaking constitutes the bimodal information presented the sighted deaf individuals, in this study it does not constitute the information that they receive, perceive, and process.

A comparison of responses between the two groups tested yields predictable differences at the phonemic, lexical, and phrasal levels for the *N* test items. Because phrases are sequences of lexical items and because lexical items are sequences of phonemic referents (i.e., allophones), it follows that differences in the perception of phonemic sequences (lexical and phrasal) might be founded in perceptual differences with regard to isolated allophones. Thus, the production of allophones is the starting point of the analysis.

According to the data, for every isolated allophone tested, responses were consistent within the group of deaf native English cuers. Likewise, for every isolated allophone tested, responses were consistent within the group of hearing native English speakers. However, as predicted, responses were not consistent between the two groups; for the *N* test items, phonemes indicated by the group of deaf native English cuers did not coincide with those indicated by the hearing native English speakers with regard to the simultaneously cued and spoken test items. Where simultaneously cued and spoken information differed linguistically, the written responses of the two groups (a) targeted different values and (b) were consistent within a given group.

The data also reveal that at least some articulatory features associated with spoken allophones were irrelevant to and/or disregarded by the group of deaf native English cuers. For example, one of the simultaneously cued and spoken test items included a two second acoustic rendering that was identified by all of the hearing native English speakers as *m*. The simultaneously produced two second visible rendering was identified by all of the deaf native English cuers as *p*. Thus, it seems that the articulatory features of cuem accept visual allophones of /p/ that contain a durative aspect. This is unlike the articulatory features of speech, which, for spoken American English, present allophones of /p/ only as non-durative plosives or stops. The data shows that with regard to the representation of at least some phonemes, the articulators of cuem accept as having a durative (i.e., +continuant) quality that which speech regards as strictly a plosive or stop (i.e., – continuant). Thus, it appears that cueing and speaking differ with regard to *manner of articulation*.

Differences in the articulatory features of cuem and speech go to the point of the current study. However, in addition to behaviors that distinguish cueing and speaking in an articulatory sense, it is also noteworthy that these differences have linguistic implications. Where the articulators of cuem accommodate duration in instances that speech might not, it is the deaf native cuers who subconsciously decide whether the visible symbol(s) generated has been ascribed linguistic value. In the example above, the deaf participants performed a subconscious linguistic exercise when they accepted as a cued allophone of /p/ a visible symbol in which duration is a feature. This piece of evidence provides some insight into the nature of cued allophones, how the attributes of cued allophones are articulator-specific, and why attributes of cued allophones are not likely to map onto attributes of spoken allophones.

Another articulatory feature associated with spoken allophones, that of ± voice, is apparently not an articulatory feature of cued allophones. For at least one of the simultaneously cued and spoken renditions of an isolated phonemic referent, the deaf native cuers wrote *p*, apparently indicating /p/ as the target phoneme while the hearing native speakers wrote *m*, apparently indicating /m/ as the target. This suggests that ± voice did not override visible information used by the deaf native cuers in making linguistic decisions. It appears that ± voice is neither necessary nor considered salient to the representation of cued allophones. Thus, it appears that *voice* is neither a distinctive articulatory feature of cuem nor of cued English.

Test item 22 included the simultaneous rendering of the cued word *kingdom* and the spoken word *hilltop*. In keeping with predicted responses, the deaf native English cuers perceived a cued allophone of /k/, transcribing *k* in the word-initial position while the hearing native English speakers perceived a spoken allophone of /h/, writing *h* in the same word-initial position. This difference in linguistic categorization by the two test groups suggests that a cued allophone of /k/ need not exist as the product of a velar production (since none was rendered). This is evidence that *place of articulation* differs where cueing is compared with speaking.

Given the design of Cued Speech, the aforementioned evidence regarding *place of articulation* is particularly intriguing. By design, Cued Speech allows spoken messages and cued messages to co-occur. Where the mouth as an articulator is concerned, a commonly held notion is that place of articulation co-occurs as well. After all, the same visible mouth configuration is used to generate simultaneously rendered spoken allophones and cued allophones.

Nevertheless, the data provide evidence that the visible features constituting a given configuration and the place of production features used to generate the given allophone are not systematically one and the same where speech is concerned. For example, a visible mouth shape accompanies the production of spoken allophones for each of the phonemes /h/, /g/, /ng/, /k/. Certainly, mouth shape is relevant to accurately generating cued allophones representing each of these phonemes. However, and in contrast, where spoken allophones of /h/, /g/, /ng/, and /k/ are concerned, mouth shape does not constitute place of articulation. Test item 22, noted above, provides evidence of this reality.

The pattern of consistency within the two groups and inconsistency between them continues with regard to lexical and phrasal responses. Still, for some isolated lexical items as well as for some lexical items within the phrasal test stimuli, written responses by the deaf native English cuers were consistent with those indicated by the hearing native English speakers. It appears that simultaneous production of cued allophones and spoken ones is possible. It also appears that cued allophones and spoken allophones can target orthographic symbols representing the same phonemic values. This is not surprising as it is consistent with the findings of previous studies. However, it is noteworthy that past studies have only examined the production and reception of cued information where the linguistic values presented in the cued mode coincided with those presented in the spoken mode.

It is, perhaps, this ability for cuem and speech to simultaneously represent equivalent linguistic values that has lead researchers and others to assume or conclude that Cued Speech entails speech. Nevertheless, the current study provides evidence that information produced via cued English and information simultaneously produced via spoken English need not coincide linguistically. Even when cueing and speaking English co-occurs, representations of the same phonemic values need not be produced by the sender nor perceived by a deaf native English cuer and a hearing native English speaker.

At the lexical level, disparity exists between the two groups tested with regard to the identification both of consonant (e.g., *trend* /trend/ vs. *dread* /dred/) and vowel (e.g., *pig* /pIg/ vs. *beak* /bik/) phonemes. At the phrasal level, the two groups also perceived differences in word boundaries (e.g., *I paid for insurance*. vs. *I met a foreign journalist*.) and grammatical function (e.g., *It could happen*. vs. *It's a good habit.)*. Given the differences across groups in the identification of phonemes, it follows that perceptual differences at the lexical and phrasal levels would occur; phonemes build the lexicon and the lexicon entails and builds the syntax of English.

Because correspondence between the two groups with regard to the identification of phonemes and word boundaries need not occur, it can be said that the articulatory features that convey these structural aspects of cued English do not correspond with the articulatory features that convey the same aspects of spoken English. Ultimately, it appears that *place*, *manner*, and *voicing* as they describe speaking 1) do not describe and 2) are not salient to cueing. Again, it appears that Cued Speech does not entail the distinctive features of speech.

Authors of the current study are quick to note the perfect correlation between expected and actual responses to test items. Such a correlation suggests the possibility of ceiling effects. It is, therefore, important to consider whether such effects, if real, would counter evidence relevant to the current question. Toward that end, the possibility must be considered that counter-indicative data would be generated in response to different test items and/or in alternate test conditions.

Counter-indicative data might yield evidence suggesting that acoustic or articulatory products of speech influence the deaf participants in at least some instances in their linguistic decision making. However, in order to serve as evidence that is actually counter to the current finding, the nature and degree of this apparent influence would need to be very specific. The influence would need to be (a) systematic and predictable within the population(s) tested, (b) other than explainable by the McGurk effect, and (c) distinctly primary, overcoming the possibility that the acoustic products of speech that influence deaf native cuers serve the same function as the visible products of speech employed by hearing native speakers.[9] In other words, evidence could only be considered counter to the current finding if it found distinctive features of speech requisite of receiving, perceiving, and comprehending cued information.

Absent such evidence, findings of the current study suggest that the linguistic decision making of the deaf native cuers predictably deferred to an autonomous set of visibly distinctive features. Moreover, because the generation, reception, and perception of phonetic and phonemic information was successfully segregated into two distinct modes, the potential impact of possible ceiling effects does not appear to be significant to the current findings.

Discussion

An implicit assumption is commonly made by researchers in previous studies of Cued Speech. The assumption is that the production and subsequent reception of cued utterances entail the production and reception of speech. Untested, this assumption has commonly allowed

[9] Visual information might be used redundantly or confoundedly by the hearing speakers of a given language. Regardless, for the hearing person visual information is not required of receiving, processing, and comprehending spoken messages. Likewise, for the deaf participants, the articulatory and acoustic information produced by speech was not compulsory to receiving, processing, and comprehending cued messages.

for data interpretation to feed conclusions that simply reinforce the assumption. Thus, it is significant that the results of the current study provide evidence counter to the conclusion that cueing entails, includes, provides, or equates to knowledge of, or competence in, either the production or reception of speech.

Four points were initially identified in this paper as possible reasons for the prevailing assumption mentioned above. Evidence counter to the assumption is provided by the current study and contextualized below in light of these four points. For convenience, the points are reprinted below as well.

1) **The production and comprehension of cued information like the production and comprehension of spoken information involves use of the mouth.**

   The current study provides evidence in support of this statement. Nevertheless, according to the current findings, evidence that the statement is true is not evidence that the mouth serves the same articulatory function with regard to the production of cued information and spoken information. In the current study, responses to cued information differs from responses to spoken information, as predicted, for the *N* test items — 50% of the simultaneously cued and spoken test material. For example, and as noted earlier, a cued allophone of /k/ and a spoken allophone of /h/ were rendered simultaneously, both allophones resulting from non-velar productions. Because a spoken allophone of /k/ would be velar and a cued allophone of /k/ need not be, it appears that the relevant place of production for cued allophones need not be the same as the relevant place of production for spoken allophones. Although the mouth is employed both in cueing and in speaking, this disparity serves as evidence that articulatory relevance of the mouth with regard to the conveyance of linguistic information in the visible and acoustic channels differs. Thus, where the reception and comprehension of linguistic information is concerned, the mouth neither functions as an articulatory instrument of speech to the deaf native cuer nor as an articulatory instrument of cuem to the hearing native speaker

2) **Cued phonemic referents and spoken phonemic referents can coincide with regard to their linguistic values.**

   The current study provides evidence in support of this statement. Nevertheless, according to the current findings, evidence that they *can* coincide is not evidence that they *must* coincide. In the current study, the responses within each group tested coincide for 100% of the simultaneously cued and spoken isolated phonemic referents. This suggests that each of speaking and cueing systematically produce phonemic referents, (i.e., spoken allophones and cued allophones respectively). The current study also finds that responses to only the *C* test items (50% of the items tested) coincide across groups. This supports the findings of previous studies that examine production and/or reception of co-presented and linguistically matched cued and spoken information. It also provides evidence that each of speaking and cueing produce allophones autonomously and with respect to different sets of articulatory features.

3) **Speakers may cue while they talk and cuers may talk while they cue.**

   The current study provides evidence in support of this statement. Nevertheless, according to the current findings, evidence that cueing and talking can co-occur is not evidence that one *entails* the other nor that the same articulatory features are relevant to both. In the current study, responses within each group coincide among group members for 100% of the items tested. However, as expected, 50% of the isolated phonemes, isolated words, and short phrases (i.e., the *N* test items) elicited different responses across the two groups tested. This is despite the fact that cued information and spoken information were rendered simultaneously. The disparity of responses across groups is evidence that cueing does not entail speaking, that speaking does not entail cueing, and that cueing and speaking are autonomous articulatory processes. The simultaneous production of cueing and speaking is simply evidence that these two articulatory processes can co-occur.

4) **Cueing employs the system named Cued Speech.**

This is a true statement. Nevertheless, because 1) articulatory relevance of the mouth with regard to the conveyance of linguistic information in the visible and the acoustic channels differs, and 2) cueing and speaking are autonomous articulatory modes and processes, the name Cued Speech might be more indicative of what motivates the cueing decisions of hearing cuers than it is descriptive of the information received and comprehended by deaf native cuers.

Implications

The claim that cueing conveys phonemic information is not disputed by this study. In fact, the current study finds evidence that supports this claim. Furthermore, this study does not challenge the claim that speaking and cueing can co-occur and can simultaneously convey the same linguistic information to deaf native English cuers and hearing native English speakers. This claim is also supported by the data collected. Nevertheless, as predicted, deaf native English cuers and hearing native English speakers derived different information from 50% of the simultaneously cued and spoken phonemes, words, and phrases — the *N* test items. The deaf native English cuers as well as the hearing native English speakers (i.e., the control group) provided responses that were consistent with the test items that they received via their respective native mode (e.g., cuem or speech) of communication. The study's finding that the linguistic information need not coincide serves as evidence that linguistic information conveyed via cueing and linguistic information conveyed via speaking are carried via two distinct articulatory sytems, even when that information does coincide. In the current study, the linguistic decisions of deaf native cuers are unaffected by that acoustic (speech) information utilized by the hearing native spoken English users. The deaf native English cuers and the hearing native English speakers systematically deferred to a different set of articulatory features when making linguistic decisions. Thus, the fact that speaking and cueing can co-occur seems irrelevant to the deaf native cuer's comprehension of linguistic structures. This suggests that speech need neither be produced nor received in order for a cued message to carry. Furthermore, it suggests that knowledge of speech on the part of sender and receiver is neither requisite of nor relevant to the linguistic integrity of cued information.

While the data reveals that the linguistic value of simultaneously cued and spoken information need not coincide, the data also reveals that they can coincide. Test items were chosen with the goal that 50% would coincide linguistically across the two groups tested, beginning at the phonemic level. In other words, for 50% of the simultaneously cued and spoken test items, the test was designed with the goal that both groups would provide responses referring to the same phoneme, word, or phrase. Responses to these *C* test items were not only consistent within each group, there was consistency between the two groups tested. While the data clearly shows that cuem is systematic and that it utilizes a different set of articulatory features than does speech, the current study also reveals that both sets of articulators (i.e., cuem and speech) can be employed either exclusively or simultaneously toward conveying the phonemes, words, and syntax of American English. This suggests that the production of speech in conjunction with cued utterances may well provide a useful redundancy when provided those deaf or hard of hearing individuals who make use of residual hearing with or without assistive listening devices.

The fact that each of cueing and speaking function autonomously suggests that Cued Speech is not inherently the “oral” system that it is often labeled. In this study, the deaf participants do not use the acoustic features of “oral” language to comprehend the utterances presented to them. Instead, deaf cuers identify as linguistically relevant a different set (i.e., an autonomously functioning visible set) of distinctive features than the set that constitutes speech. Where place of articulation, manner of articulation, and voicing status are the salient features of speech production, cued utterances are autonomously generated via hand shape, hand placement, and mouth formation (see Appendix A).

When presented with the whispered form of a familiar spoken language, hearing people can recognize and process the remaining acoustic information as an acoustically impoverished spoken message. Findings of this study raise an interesting parallel issue: Does absence of hand shapes and hand placements present deaf native cuers a similar exercise? Specifically, when presented with the mouth-only version of a familiar cued language, is the visible mouth information that remains (in the absence of hand shapes and hand placements) processed as part of a visibly impoverished cued message rather than as part of an acoustically impoverished spoken one? In other words, to a deaf cuer, is what some would assume is “speechreading” actually more like receiving visibly “whispered” cueing than like receiving silent speech?

This study does not examine how deaf native cuers use knowledge of cued English if learning to speak English nor how hearing native speaker use knowledge of spoken English if learning to cue English. Thus, the findings do not challenge the possibility that cued phonemic referents (allophones) and spoken ones can be coordinated. However, because the current study reveals no inherent relationship between the distinctive articulatory features of cuem and of speech, it seems that any relationship between one and the other is contrived, perhaps as a strategy for teaching a cuer how to speak or a speaker how to cue. Given that deaf native English cuers recall cued linguistic values without demonstrating access to how speech is articulated (i.e., air is exhaled and channeled inside the mouth/nose in the presence or absence of voice) or what it articulates (e.g., acoustic allophones), it appears that cueing and speaking are processes that employ autonomously functioning articulatory systems. That is, even for those sighted deaf or hard of hearing people who choose to make use of residual hearing with or without assistive devices, cueing provides the necessary and linguistically relevant information visually, whether or not it is accompanied by speech production or speech products.

Traditional definitions and most of the relevant research have associated *Cued Speech* with speech, speechreading, and/or sound. The current study finds evidence suggesting that such definitions and research do not accurately refer to the salient articulatory information sent to, sent by, sent among, or perceived by deaf native cuers. In fact, because findings of the current study indicate that the visible articulatory products of cueing function autonomously and do not entail the visible and acoustic articulatory products of speaking, it would be inaccurate to describe deaf native cuers as responding to *spoken* English rendered via Cued Speech; because speech is not conveyed, it is not *spoken* English that is conveyed when English is cued.

This study also finds that deaf native English cuers are able to consistently identify phonological, lexical, and syntactic aspects of English. Perhaps the only way to reconcile the current study's several findings is to conclude that deaf native cuers respond to a cued version of English rather than to a spoken version of English that is rendered via Cued Speech. Even if hearing cuers think that they are cueing speech, the current study suggests that it is language (i.e., linguistic structure) rather than speech that deaf cuers perceive and process when receiving cued messages. Thus, just as the terms *spoken language* and *spoken English* denote both a mode of communication (spoken) and refer to that which is communicated (language/English), findings of the current study suggests that the terms *cued language* and *cued English* accurately represent the articulatory (cued) and linguistic (language/English) products of cueing.

Findings of this study provide evidence that 'mode in, mode out' consistency might be important to the process of human linguistic development. Specifically, these findings extend the idea of *natural* language acquisition beyond the fact that early language exposure in any wholly accessible mode seems critical for language acquisition. It seems that deaf individuals who are provided input via a cued language and produce output via a spoken language are performing an exercise in changing linguistic form (i.e., mode), a process also known as transliteration. Transliteration is not a stage in natural language development. Thus, for those deaf children who receive, for example, cued French toward developing their literacy in written French, even the simple expectation that they cue French expressively could make a positive difference in the natural acquisition of phonological representations (for example, see Leybaert 1998). Findings of the current study have implications for those who make decisions regarding the rationale and approach for children who cue English, French, or other languages.

In the current study, the deaf participants, like those in Nicholls (1979) and Nicholls and Ling (1982), do not demonstrate any significant performance difference when presented the acoustic plus visual input or the visual-only input. Rather, the visual-only input provides complete linguistic information at the phonemic, lexical, and syntactic levels. As it relates to the current study, this visual-only input is the product of a set of features distinct from the set that generates the products of speech. Thus, evidence of an autonomous and completely visual articulatory system serves to counter the sound-based characterization of cueing that was once assumed.

The role of the cueing hand in the perception of cued messages has traditionally been characterized as augmentive to speech and supplemental to spoken language. Researchers and others seem to have assumed a priori the notion that findings about Cued Speech relate to the effectiveness of augmenting speech via hand cues (Nicholls, 1979; Nicholls & Ling, 1982; Périer, 1987; Leybaert & Alegría, 1990). Certainly, prevailing descriptions and discussions of Cued Speech accept the speech-supplement view as fact. Nevertheless, outside of the current study, none has been designed specifically to determine whether the requisite articulatory features of cueing function autonomous of, rather than augmentive to, those required of speaking. In other words, no study has tested what most, if not all, seem to have assumed. That assumption has, thereby, implicitly functioned as a null hypothesis in those studies. Thus, it is significant that findings of the current study 1) are the only evidence to date resulting from testing the assumption and 2) provide compelling evidence counter to the integrity of that assumption.

From a theoretical perspective, this counterevidence has interesting implications. For example, as it is applied in the literature, the term 'supplement' suggests that the tripartite features of speech are part of and salient to the production, reception, perception, and/or processing of cued messages. Findings of the current study indicate otherwise. In fact, implications of the current findings suggest a paradigm shift in terms of how cueing is characterized. Instead of supplementing the voice, manner, and place features of spoken languages, it appears that the hand shapes, hand placements, and mouth configurations of Cued

Speech function autonomously as some of the features that define *cued languages*.

From a practical perspective, the current findings suggest that for parents of deaf children and the professionals that work with them, the decision to cue a particular language is not limited by the hearing acuity of the receiver. Nor is the decision constrained by the receiver's ability to access, perceive, process, or produce the features of speech. Nor is the decision detrimental to the use or development of any of these abilities.

In light of the current findings, it appears that, both individually and collectively, voice, manner, and place of articulation for speech are not systematically present in the articulation of linguistic information via cueing. This might explain why deaf cuers who wish to speak go through the same speech training exercises as oral or signing deaf youth might, at least to a point. If speech is a goal, one advantage to the deaf cuer might be that the linguistic segmentation provided by cueing parallels that provided by speaking. That segmentation can subsequently serve the speech therapist as a relevant point of reference for associating linguistic knowledge with speech production. Essentially, because the deaf cuer has already acquired linguistic segments via exposure to the visible symbols of a particular cued language (e.g., English), the speech therapist can reference those segments when teaching the deaf cuer how to produce the acoustic symbols of the counterpart spoken language (e.g., English). This is one reason that acquisition of a cued language might support oral/aural and even auditory/verbal goals.

Findings of this study also serve as strong evidence that sufficient exposure to a cued language provides for acquisition of the scope of linguistic structures beginning at the phonologic level and do so completely in the visual mode (cf Metzger, 1994; Hauser & Klossner, this issue). Thus, providing appropriate exposure to cued English, for example, appears to support the goals of those interested in acquisition of English but without necessitating use of or dependence on speech and/or audition.

In a practical sense, consistently exposing a sighted deaf individual to a cued language in natural interaction seems to provide for the development of native or native-like competence in a given consonant-vowel language, including that of hearing family or friends as well as foreign languages studied in school. Findings of the current study suggest that cueing does this without the need for speech production, speech reception, or knowledge of either. Thus, as a completely visible articulatory process, cueing a language supports the goals of those interested in visual language and written literacy development in mono-lingual and multi-lingual contexts.

The distinction between language modality and language structure prompts the need to re-examine discipline-specific application of research findings. This distinction suggests, for example, that "inner speech" as a construct is not limited to traditional notions of "speech" or "speech perception." Recognizing that deaf native cuers can internalize through an autonomous visual articulatory system the phonological, morphological, and syntactic aspects of traditionally spoken languages has implications for a variety of disciplines, including psychology (e.g., language perception, neurofunctional localization of the brain), linguistics (e.g., language acquisition and the development of literacy), and education (e.g., bilingual and multilingual programming). Related issues in each of these disciplines are ripe areas for further research.

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