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The use of hand gestures as self-generated cues

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THE USE OF HAND GESTURES AS SELF-GENERATED CUES

by

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In a series of two experiments, the effects of viewing hand gestures as cues for verbal retrieval was demonstrated. Subjects that were cued with their own self-generated hand gestures for cues retrieved more target words than subjects that were shown someone else's hand gestures or subjects that received no gesture cueing. This effect was consistent across a two-week retrieval period and remained unchanged when the cueing order was different than the input order. In addition, the experiment revealed that concrete words resulted in greater gesture production than abstract words, but that a meaningful gesture was just as effective as a cue for an abstract word as it was for a concrete word. Subjects with high SAT verbal skills produced more gestures than subjects with low SAT verbal skills, and high SAT subjects also benefited more from gesture cueing than low SAT subjects. One other interesting finding was that of incubation and hypermnesia effects in subjects cued with their own gestures. The results are discussed in terms of imagery and information-processing facilitation, as well as episodic and semantic memory.

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DEDICATION

This dissertation is dedicated to the memory of my father

Aaron Lewis Frick.
1926 - 1972

CHAPTER I

INTRODUCTION

The production of hand gestures during verbal output is a behavior that occurs frequently during human communication. Gestures have been shown to function in a variety of ways that can substitute, supplement, facilitate, or emphasize the accompanying speech output for communicative purposes. It has been demonstrated in a wide variety of cognitive tasks that the recipient, or decoder of the gesture production benefits from the nonverbal presentation. The facilitating effects of gestures has been found to enhance such tasks as recall, recognition, conceptualization, and verbatim duplication of verbal information. For example, Graham and Argyle (1975) showed that subjects who viewed gestures in conjunction with auditory descriptions of geometrical designs were better able to duplicate those designs than were subjects who did not view gestures with the verbal descriptions, and that the greater the complexity of the design, the greater the effects of gesture viewing.

Similarly, Rogers (1978) demonstrated the beneficial effects that gestures have on comprehension of verbal descriptions. In this experiment subjects heard a series of descriptions of action events at four different levels of background noise. The action events included such descriptions as a tennis ball bouncing into a corner. The auditory description was presented with or without gesture accompaniment. Subjects in the group with gesture illustration demonstrated better comprehension for the verbal content than subjects not exposed to gestures. In addition, the gestural facilitation was a linear function of the increase in noise levels.

Similarly, Berger and Popelka (1971) gave subjects a series of sentences where they were to write down the verbal message verbatim. One group of subjects heard the sentences with accompanying gestures while the second group was without gesture presentation. Although these gestures were the type of gestures that are learned symbols or emblems (Efron, 1941) which exemplify a particular phrase such as a thumbs up sign, subjects were more likely to reproduce the entire sentence when exposed to these gestures than subjects who were not shown gestures.

Other studies reporting similar results of gestural facilitation focus on the increased performance on story comprehension, perceptual identification, recognition, and recall of the verbal material. Riseborough (1981) reports that in three experiments subjects were better able to identify described objects when gestures were used. Further, she showed that subjects could better comprehend a story told during high levels of noise when there were accompanying gestures than when there were not. Finally, she reported that recall of stories and word lists were facilitated when the story was augmented by gestures.

Thus, it is clear than gestures aid the decoder in a wide range of tasks, suggesting that one function of gestures is to aid communication between two or more people. Kendon (1980) proposes that gesture use is primarily for communication purposes and functions as a unit of expression along with speech so as to form one unified utterance unit.

Classification of Gestures.

There are several distinct types of hand gestures that serve a number of different functions within speech production. Classifications of the more common hand gestures have included emblems, regulators, adaptors, and illustrators (Ekman & Frissen, 1969).

Emblems are gestures that are culturally learned and have a direct corresponding verbal translation (Ekman & Frissen, 1969). An example would be the thumb and middle finger encircled to indicate the sign for O.K., or a shrug of the shoulders to indicate "I do not know". These gestures are explicitly used as a means of communication between two or more persons.

Regulators are gestures that are used as a means of regulating or emphasizing the conversation and have no communicative value. Included in this category are "beats" (McNeill & Levy, 1982) which are described as short rapid or chop-like motions that are related to the tempo of the speech. They are nonsemantic in content and serve to add emphasis to parts of the sentence. An example would be a series of karate type movements that are synchronized with a set of words in a sentence.

Adaptors are the type of gesture usually associated with self-touching and are described as functioning to reduce drive, anxiety, or emotion (Ekman & Frissen, 1969). An example might be patting the leg with the palm of the hand, or jiggling the whole body. A more comprehensive category of these gestures is described by Freedman (1977) as body-focused gestures. Although these gestures are thought to bear no direct relation to speech, they have been shown to serve as a tension regulating or attention-focusing mechanism (Barroso, Freedman, & Grand, 1978; Freedman et al, 1972; Mahl, 1968; Steingart & Freedman, 1975). For example, body-focused gestures are thought to serve to focus a person's attention on a verbal task whenever there is interference with verbal production (Barroso, Freedman, & Grand, 1978). Barroso et al (1978) found that the incidence of body-touching increased when subjects were given a Stroop test, and that body-touching and number of errors were inversely related. This indicates that the gesture of body-touching might aid speech processing whenever the producer might encounter problems.

A third category of gestures is that of illustrators. This category includes the type of gestures described by Freedman (1977) as object-focused movements, and by McNeill and Levy (1982) as iconic gestures and metaphoric gestures (McNeill, 1985). These gestures (referred to as iconic or metaphoric henceforth) are used to represent the imageable meaning of the verbal content of a word. For example, an iconic gesture can depict an object's shape (such as square), illustrate an object's function or operational usage (such as how to open a door), or illustrate the concept of a word (such as opening a clenched fist to illustrate the word "blossoming").

Metaphoric gestures involve the use of a concrete gestural representation of an abstract word or phrase. Generally they reflect an idiosyncratic image or representation of an abstract word. One example is the phrase "a direct limit" which might be accompanied by one finger moving horizontally across the speaker's center until halted in its path by the other hand (McNeill, 1985).

Developmental Origins of Gestures

One of the earliest forms of communication that children employ is that of hand gestures. Children pat, point, motion, and enact any number of motoric movements in order to make their desires known. Children under 15 months can depict objects and animals, express direction and locations, indicate desires and intentions, and demonstrate precise attributes by employing non-verbal gestures (Acredolo & Goodwyn, 1985).

These gestural forms are not expressly taught to the child but seem to have developed spontaneously. Goldwin-Meadow and Feldman (1975), for example, have shown this behavioral development occurs automatically in deaf children. In fact, it has been shown that both hearing and deaf children have similar systems of gestural communication that decline in hearing children with the onset and sophistication of speech, but increase during the deaf child's development (Goldwin-Meadow & Morford, 1985). This suggests that the reliance on gestures as the primary means for communication may decrease as the acquisition of language develops, and that rather than disappear, the gestural component becomes a secondary component to speech.

Other research has indicated the interconnection between gestural acquisition and language development. Piaget (1962) suggested that motoric enactments are the precursors to the acquisition of verbal signifier. More current research indicates that gesture is the forerunner of speech, but that gesture and speech then continue along parallel lines of development (Bates, 1979). In fact, Church and Goldwin-Meadow (1986) have demonstrated that children spontaneously gesture when asked to verbally explain a cognitive task. They also found that a mismatch in gesture and speech production, whereby the information in the speech did not match the information given in the gestures, (i.e. supplemental gestural information), predicted a greater readiness to be trained for conceptualization of the cognitive task than in children with no inconsistency in speech and gesture (see also Perry, Church, & Goldin-Meadow, 1988). This indicates that in cognitive development gesture use may precede speech acquisition and be an indices for cognitive understanding.

Several studies focus on the developmental issue of increased gestural sophistication as a function of age (Evan & Rubin, 1972; Jancovia, Deboe, & Wiener, 1975; Wilkenson & Reinbold, 1981). Freedman (1977) observed that children's gestures become more selectively associated with the acquisition of more meaningful units of speech. Developmentally, gestures also become less egocentric. A child will relate a story with pantomime gestures as if he were the center of the story while an adult will enact the story as a witness (McNeill, 1985). McNeill (1986) states that children's gestures are different from adults' and develop through several stages from denotative to symbolic sophistication.

In short, children begin with overt motor enactments to illustrate desires and cognitive concepts. As suggested by Piaget, the gesture enactment is the forerunner to speech acquisition and is the first component of a sequence of language competencies. This ultimately results in the sophisticated and interrelated communicative system of gesture and speech produced by the adult.

Gesture Use Outside of the Communication Function

Much less attention has been paid to the possible function that gestures might serve for the producer as opposed to the receiver of the message. Some evidence that gestures may serve an important function other than communication for the speaker derives from studies which manipulated whether or not speakers were aware that recipients of messages could see them talking. Mahl (1968), for example, observed that subjects would continue to use both body-focused and iconic gestures during communication with another person even though the two communicators were seated facing away from each other. Similarly, Cohen (1977; Cohen & Harrison, 1973) required subjects to give directions either face to face with listeners or via intercom. These studies found that the rate of gesture production was only slightly greater when subjects communicated in person than indirectly, suggesting that an audience is not the decisive factor for gestural use.

Further evidence is cited by Blass, Freedman, and Steingart (1974) whereby they have found that congenitally blind subjects relied on body-focused gestures while relaying verbal information but produced no gesture communication during periods of silence. Further they state that the quantity of gestures was linked to the complexity of the verbal information. Since these blind subjects had never viewed gesture production in others, it seems likely that their production was a natural occurrence that accompanied speech output.

These studies indicate that gesture use could function to aid the producer in some way independent of communicative purposes. Indeed, Feyereisen (1987) states that gesture use is not for communication purposes, but rather relating to the information-processing activity of translating ideas into spoken words. Thus, it seems likely that gestures and speech are coordinated systems expressing different component of the language system.

Neurological Evidence of the Relationship of Language and Gesture. Neurological research suggests that speech and gesture are separate but concurrent units of information-processing representations. In addition, this research shows that deficits in one mode are accompanied by deficits in the other mode and that this dysfunction can operate at either the decoding and/or production phase of speech. For example, Varnery (1987) has demonstrated that patients with impaired ability to decode gestures also suffer from Wernicke aphasia (see also Goodglass and Kaplan, 1963: Duffy & Liles, 1979). Similarly, Cicone, Wapner, Foldim, Zurif, & Gardner (1979) report that subjects with either Wernicke's or Broca's aphasia produce degraded gestures equivalent to their verbal dysfunctions. For example, Wernicke patients whose speech is typically more fluent, but less semantic, rely more heavily on the type of gesture typically used to punctuate speech without aiding the semantic content (Pedelty, 1987). Cicone et al (1979: 332) found that Wernicke's patients produce gestures that are "frequent, relatively complex, and often elaborated" but confusing and nonsemantic in content. Conversely, Broca's patients, who produce speech that is typically nonfluent but semantically correct, use far more iconic gestures that illustrate the semantic content of the speech than any other kind of gesture.

Broca's patients' gesture use is sparse, and frugal, but "generally informative" (Cicone et al., 1979: 332). Although Cicone states that gesture and speech are separate outputs, he concludes they are under the control of one central processor.

This seems to indicate that there may be a deficit in the interaction between speech and gesture that is necessary for the production of both syntax and content in normal speech and gesture production. McNeill (in press) concludes that normal speech and gesture production requires and is a function of the interaction between both hemisphere's contribution to the overall verbal package. This suggests that gesture and speech are separate representations of memory events, but that they are activated simultaneously and possibly share a common output planning stage.

Speech and Gesture as Independent Representations.

Following the above line of reasoning, it seems likely that one possible function that gestures may serve for the speaker is as an auxiliary code to aid the speaker in lexical retrieval. Gesture enactment may serve to activate an additional representation of the verbal material by expressing other components of the word, thereby cueing lexical access. Posner (1967) suggests that visual, motoric, and verbal information can be accessed independently. In terms of developmental acquisition, where gestural acquisition precedes verbal production, it seems likely that the motor component of memory may have developed first, followed by a verbal representation. Indeed, in preoperational children, it has been demonstrated that gesture production may be semantically correct in some problem-solving tasks even when the verbal information cannot be expressed correctly (Church and Goldin-Meadow, 1986), suggesting that gestures and speech are at some point independent representations. McNeill (1975) also found incidents where the gesture was semantically correct at output and the verbalization was only later corrected by the producer. Further observations have confirmed that it is typically the gesture production that correctly illustrates the description and the verbal information that is inaccurate. This would indicate that the two representations are separate, but must share some interaction to produce simultaneity of output. Confirming this view, Levelt, Richardson and Heu (1985) demonstrated that gestures and speech are interactive and flexible at a semantic planning stage. However, gesture production is independent at the time of motor execution, while speech production is adaptable to gesture information for a brief time, after which both productions become independent. Again, this suggests that gestures precede speech both in acquisition and production, and although interconnected at output, remain separate representations of a memory event.

Another possible function that gestures may serve for the speaker is that they may illustrate the speaker's mental depiction of the object or event. Consistent with this view, McNeill (1985) has characterized gestures as being an overt manifestation of a speaker's mental representation, while Freedman and Steingart (1975) characterize gestures as motor acts that depict the speaker's information-processing activities. This implies that gestures are either a part of the encoded event or symbolically embody the memory code.

This position is consistent with that of Saltz and Donnenwerth-Nolan (1981) which states that during the act of processing a verbal event, motoric images also are activated since they represent an inherent component of the word's semantic meaning. Their conclusions are based on an experiment in which they found that accompanying verbal items during encoding with the enactment of an associated motoric action resulted in facilitated recall for those objects over objects without motoric enactment. Similarly, Backman, Nilsson, and Chalom (1981) concluded that motoric elements of an action event are encoded automatically with the verbal event. Thus, it is possible that motoric enactments function by aiding the speaker as an auxiliary code in lexical retrieval. Supporting this view, several studies have found that speakers are also likely to produce gestures when there is a breakdown in verbal retrieval (Kendon, 1972; Riseborough, 1982; Werner & Kaplan, 1963). Butterworth & Beattie (1976) found that iconic gesture use occurs more often during 1000 seconds of verbal hesitation than per 1000 seconds of speech (although, of course, there is more incident of speech than silence so that overall gesture use during speech is far more prevalent than during hesitations). This suggests that the gestures used during periods of hesitation may provide an additional retrieval cue for the searched-for word, thereby aiding lexical access. It has been shown, however, that gestures produced during a tip-of-the-tongue (TOT) episode do not aid retrieval of the searched for word (Frick & Guttentag, 1990). Self-generated gestures do, however, serve to facilitate subsequent free recall of the gesture-accompanied verbal material even when the material was originally an unretrieved TOT (Frick & Guttentag, 1990). This suggests that gestures might operate as an optimal retrieval cue for recall of verbal material, but only under certain conditions. The question remains as to exactly what the conditions are in which gestures can serve to aid retrieval of a verbal event.

Episodic Memory Retrieval

Retrieval of a memory event is viewed as a process that is dependent on the quality of the retrieval cue to activate the memory trace (Tulving, 1982). The degree of memory activation is a function of the threshold requirements of the retrieval task and the subsequent qualitative and quantitative properties of the retrieval cue. According to Tulving's (1982) model of retrieval, the to-be-remembered event is encoded into a memory trace whose resultant properties are a combined function of 1) operations performed on the trace, 2) the cognitive environment at the time of encoding, and the 3) characteristics of the event or item itself. Retrieval, then, occurs when the system is in the presence of an appropriate retrieval cue. Tulving's encoding specificity principle states that memory retrieval of an event is a function of a match between information in the retrieval cue and information contained in the memory trace concerning the original event (Tulving & Thompson, 1971). This is consistent with other research that specifies the necessary conditions of a study-cue test-cue match for retrieval. This includes Test Appropriate Procedures (Roediger & Blaxton, 1987), environmental context dependency (Smith, Glenberg, and Bjork, 1978), state-dependent memory (Bower, 1981), and later work on levels-of-processing (Fisher and Craik, 1977). For example, Roediger, Weldon and Challis (1990) demonstrated that study sessions that are directed toward data-driven processing result in better performance at test if the task is also data-driven rather than conceptually-driven. Conversely, conceptually-driven study-test matches also result in better memory at test than if the study session is opposite the test session in its processing demands.

Similarly, Bower (1981) found that subjects that were in a particular emotional state at encoding performed better on a task if they were in the same emotional state at the test session than if they were in a different emotional state. Likewise, Fisher and Craik (1987) demonstrated that encoding conditions such as rhyming or semantic orientation resulted in better recall for the target words when there was consistency between the encoding and the retrieval environments, although semantic targets still retained the performance advantage over nonsemantic regardless of study-test match. They conclude that the uniqueness of a semantic cue results in a more distinctive memory trace which in turn results in better memory for an event.

Gestures and the Episodic/Semantic Memory Distinction

Thus, the relation between encoding and retrieval is specific to the overlap of the two events. It could be assumed then that any type of processing, or any unique event that occurred at the encoding stage, if activated at retrieval, should result in better recall of that event. Since hand gestures are thought to be a manifestation of the information-processing that occurs during production of a verbal event, it seems likely that viewing those same gestures at retrieval would replicate the study condition and they would function as effective memory cues at test for the same verbal material. Therefore, hand gestures could function as good memory cues for the events of which they were representative. Supporting this view, Woodall and Folger (1978) demonstrated that viewing hand gestures can serve as effective episodic retrieval cues for the co-occurring language target. They showed that recall of target words could be facilitated even if the gesture were only a linguistic regulator and contained no semantic information. They further found that semantically related gestures produced higher rates of recall than nonsemantic gestures. They argue that semantic gestures carry context cues that allow for greater elaboration in processing and thus, greater retrieval. They further argue that the encoding specificity principle is deficient in providing specific guidelines that would allow prediction of which features would be encoded in a context outside of list learning. More specifically, in a natural language context, the semantic content of gestures is integrated with the verbal target and provides a context cue that allows elaboration processes to occur. However, the gestural context cue may be confounded by visual and linguistic attributes that are available to the encoder and may result in unpredictable cue encoding. They conclude that the assessment of nonverbal gestures as retrieval cues cannot be determined precisely without consideration of both the availability and specific cue selection of the encoder.

The above study was specific to a natural conversational context and did not address the issue of gesture production. However, this does address an important question in the context of the present experiment. If hand gestures are semantic representations of the memory event would they then be context independent and serve consistently as retrieval cues of the verbal target or, since they are produced at the time of verbal production, are they episodic cues for retrieval of a specific event. The present study could be discussed within the episodic/semantic framework, but this study is not designed to address these questions. Rather, the present study is concerned with examining the power of gestures to cue verbal information. In other words, the question addressed in the present study is what are the effects of gestures as cues for verbal information regardless of whether the memory is generic memory or memory for a prior event.

Cue Effectiveness for High Levels of Retrieval

Other research has shown that the facilitation of memory performance can be improved by using cues that are appropriate to self-related perceptions. For example, Rogers, Kuipers, and Kirker (1977) found that subjects' memory for adjectives involving personality traits that were thought to be self-relevant was better than their memory for adjectives thought to be unrelated to one's self. They have proposed that self memory, which includes episodic memory, taps into a processing network based on a self-schema. At time of recall, the subject simply references this self-schema and uses it as a checklist for the target items. Thus, self-related material facilitates retrieval for that material because the subject "can use the self as a retrieval cue" (Rogers et al., 1977, p.686; see also Bower and Gillian, 1979).

Memory facilitation enhanced by self-related cueing can be seen to be advantageous for retrieval because self-related cues can easily be viewed in terms of distinctive cues. Cue-distinctiveness is an effective retrieval aid because the constraints of the cue minimize the number of possible retrieval targets (Einstein & Hunt, 1980; Hunt & Einstein, 1981; Hunt & Elliot , 1980; Mantyla & Nilsson, 1988; Watkins & Watkins, 1975). Mantyla (1986) found that by using distinctive cues in a consistent study-test cue environment, subjects can recall long list of unrelated items over long retention intervals. In a similar study, Mantyla and Nilsson (1988) found that the cues, however, had to be self-generated by a subject in order for them to be effective retrieval cues for that subject. In a series of three experiments, subjects were asked to produce distinctive adjectives describing the properties of a target word. After a three to six week period, subjects were given a recall test with the self-generated distinctive adjectives as cues for the target word. Self-generated cues that were distinctive resulted in better memory for the target words than nondistinctive generated cues, and the recall rate remained constant over long retention intervals. They conclude that it is the distinctiveness of the cue that produces better memory for the event because the cue effectiveness remains constant over time and over changing context.

Hand Gestures as Good Memory Cues

In summary, one characteristic of cues that aids memory retrieval is distinctiveness. This particular cue environment is found in situations where cues are self-generated or self-related. As most self-generated cues involve an intentional production by the subject, it has been argued that the effort of the process is one additional reason that these cues are good memory cues (Slamecka & Graf, 1978). The advantages of the generation effect has been widely demonstrated (Anderson, Goldberg, & Hidde, 1971; Gardiner, Craik, & Bleasdale, 1973; Graf 1980, 1981, 1982; Jacoby, 1978, 1983; Slamecka & Fevreiski, 1983; Slamecka & Katsaiti, 1987). It has been shown that attempting to generate an item and failing results in better memory for those items than items not generated (Gardiner, Craik, & Bleasdale, 1983), again suggesting that it is the intentional effort of the process that results in better memory performance.

However, hand gestures are the unintentional production of self-generated cues. Since hand gestures are thought to be processed automatically, with small resource demands (Wiener, Devoe, Rubinow, & Geller, 1972), it could be argued that if self-generated gesture cues function to aid memory that it would not be due to the effort of the production, but rather to their distinctiveness to the producer.

Supporting this interpretation, generally a gestural enactment of a verbal event is a highly personal and idiosyncratic representation of a memory event. McNeill (1991: 14) states that a person's hand gestures are "idiosyncratic images of past and future". The nature of idiosyncratic cues are thought to be good cues for memory because of the greater distinctiveness that they hold for the producer (Mantyla & Nilsson, 1988). In other words, idiosyncratic cues highly specify a to-be-remembered event across long retention intervals due to encoding and retrieval compatibility and cue distinctiveness (Backman & Mantyla, 1988). Whether it is the case that gestures are a distinctive representation of a memory event and/or idiosyncratic to the producer, they should function as excellent retrieval cues for a memory event. In addition, if the production of gestures during verbal output can be viewed as the study condition, and recall of the verbal output at a later time can be viewed as the test condition, then cueing with those gestures would be the natural study-cue test-cue condition for retrieval, since, as stated, they are the embodiment of the memory representation. If this is the case, then gesture cueing for verbal recall should fit all the criteria for the conditions of the highest retrieval probability and should maintain these conditions over long periods of time.

Gestures as Distinctive Cues Over Long Retention Intervals

As stated, cues that are distinctive remain effective retrieval cues over long periods of time, particularly if these cues are self-generated (Mantyla, 1986; Mantyla and Nilsson, 1983). Mantyla and Nilsson (1988) demonstrated that recall of a list of words that were cued by self-generated, distinctive nouns declined by less than .05 percent in a retention period of 3 weeks. Mantyla and Nilsson (1988) conclude that by providing a cue that retains its distinctiveness the variability in semantic meaning is reduced and the cue consistently constrains the event even in different contexts and over long retention periods.

Since gestures are self-generated cues that are thought to be distinctive, idiosyncratic representations of a person's memory event, it seems clear that gesture cues should remain constant over time even if they are produced unintentionally. The memory code for that event can be reactivated at later retrieval due to the effectiveness of the unique cue in the process of reconstructing the original event (Mantyla and Nilsson, 1983).

Gesture Use as a Function of Imagery and Verbal Skill

There are several studies that suggest that gesture use is related to a person's cognitive imagery skills. For example, Rime, Schiaratura, Hupet, and Ghysselinckx (1984) found that when subjects were restrained from movement during an experiment, their verbal expressions had a significant decrease in the number and type of words considered high in imagery. In other words, in a 50-minute conversation with the experimenter, during which subjects were restrained so that their gestural ability was restricted, these subjects produced significantly fewer words that were considered imageable (see also Graham & Heywood, 1975). This implies that gesture use and imagery may be related in processing of verbal tasks. In fact, Goss, Hall, Buckolz and Fishburne (1986) report that subjects who were tested as having high imagery skills were also able to more easily acquire and retain certain body and hand movements than those subjects with lower imagery skills. This indicates that gesture use may access an imageable component of the memory representation.

Other researchers have also found similar associations between imagery skills and gesture use. Freedman, O'Hanlon, Oltman, and Witkin (1972), for example, determined a relationship between a subject's verbal abilities, imagery skills and pattern of gesture use. In their study they found that subjects who were classified as being field-independent use significantly more gestures than subjects who were classified as being field-dependent (FD). FI is defined as having the ability to verbally articulate the distinctive boundaries of figure-ground in a visual perceptual field. In addition, FI persons have higher imagery skills and verbal skills than FD persons. Conversely, FD persons have trouble translating their visual conceptualizations into words. Sousa-Poza, Rohberg, & Mercure, 1979 found that FI subjects used more object-focused gestures, i.e. iconic gestures, than FD subjects, whereas the FD subjects used more body-focused gestures which are thought to serve the function of focusing attention (see also Sousa-Poza & Rohrberg 1979).

These results indicate a close relationship between imagery and gesture use and imply an indirect association with verbal skill. In fact, other data that links hand gestures to imagery skill also indicates that verbal skills are an important component to speech processing. For example, Frick and Guttentag (1990) found that subjects with high SAT verbal scores used more iconic gestures while correctly retrieving a lexical item than subjects with low SAT scores. Further, high scoring SAT students used significantly more body-focused gestures when they missed a lexical item than subjects with low SAT scores (see also Baxter, Winter, & Hammer, 1968; Hoffman, 1968). This indicates that gesture production is a function of general verbal skill, but does not answer the question of the relatedness of the imagery, verbal, and motor processes.

One study that illustrates the differences in these processes is that of Saltz and Donnerwerth-Nolan (1981) in which they demonstrated that visual imagery, motor enactment, and verbal encoding all result in differential memory performance. They showed that visualization of a target word resulted in better memory performance than motoric enactment, but both visual and motor images resulted in better memory than mere verbal encoding. They conclude that motor images and visual images have different processing modes and thus, the processing of motor movements functions differently from that of imagery and both function differently from verbal processing.

These results still do not directly address the question of gesture use as a general byproduct of verbal skill and imagery processes. One way of distinguishing the relationship among these processes would be to view gesture use as a function of a word's imagery value. For example, when determining differences in gesture use for FI and FD persons, Sousa-Poza and Rohrberg (1979) found that both groups used more gestures for concrete word tasks than abstract word tasks, but that FI persons, who have higher verbal skill used more iconic gestures overall, and more iconic gestures than the FD persons. They concluded that gesture use is greater for concrete tasks than abstract tasks, and that this is a natural consequence of the imagery value of the words. Thus, it seems likely that gesture use is a byproduct of verbal skill and imagery value, with the higher levels of verbal skill predicting the greater production of gestural movements, particularly when processing words with high imagery values.

One question that has not been addressed by these studies is how the interaction of gesture cueing, verbal skill, and the imagery value of a target word can affect memory performance. As it has been stated, gesture use is greater for concrete words than abstract words and particularly for subjects with high verbal skill. In addition, concrete words are usually remembered better than abstract words (Paivio, 1971). Thus, a natural prediction would be that subjects with high verbal skills should produce more gestures and have greater memory for concrete words than in subjects with low verbal skills. In addition, since iconic gestures serve to illustrate the imageable aspect of the target word and concrete words have higher imagery values than abstract words, then gestures produced with concrete words should serve as better retrieval cues for those target words than gestures produced with abstract words. However, Lesgold and Goldman (1973) propose that in self-generated imagery cues for concrete words that it is the uniqueness of the cues that is responsible for better memory, not the image itself. Since gestures have been proposed to be good cues for memory due to their uniqueness, gestures might serve as distinctive cues for memory regardless of the imagery value of the target word or the imagery within the gesture. If this is the case, then there should be no differences in recall as a function of a word's concreteness as long as a gesture is representative of the verbal target.

Purpose of the Present Study

To summarize, gestures are typically thought to operate in aiding communication in a wide variety of cognitive tasks. However, people use gestures when not in any communicative role and the exact function of gestures for the producer is unknown. One possible function of gestures is as a retrieval cue to aid verbal production.

Since gestures and speech develop along parallel lines, it is reasonable to assume that they are part of the same representational system. It has been hypothesized that gestures are the mediator between thought and word (Feyereisen, 1987). Evidence that gestures are a major component of speech production stem from studies where gestures are restricted and the resulting verbal production is not the same as when gestures are permitted (Rime et al., 1984). Likewise, gestures and speech have been shown to develop simultaneously and impairment in one mode results in impairment of the second mode indicating the interrelated production.

Other researchers have found gestures use to be the precursor to cognitive understanding (Church & Meadow-Goldwin, 1986) or preceding the conscious awareness of verbal material (Mahl, 1968). These results seem to indicate that gestures serve more of an information-processing function within the verbal process.

In a similar vein, some research has focused on gestures as part of the semantic memory trace. McNeill (1985), for example, hypothesizes that gestures are overt replicas of the mental representation. Frick and Guttentag (1990) validate this proposal by showing that during a tip-of-the-tongue episode, subjects revert to an illustrative gesture of the sought after word.

Further, as gestures are self-generated, idiosyncratic, and distinctive, they should be effective recall cues for the co-occurring verbal target that they express. Because they are thought to be a consistent part of the memory trace, gestures should also retain their value as good retrieval cues over long periods of time.

Thus, it is clear that one possible function of gestures is as a cue for a memory event. The primary purpose of the present study was to determine whether or not gestures serve as effective retrieval cues for their representative verbal target. It is hypothesized that gestures will serve as good retrieval cues for lexical targets because speech and gesture are part of the same unit of lexical representation. In addition, it is predicted that the facilitation of retrieval due to gesture cueing will be specific to the producer. Thus, a subject shown their own gesture cues should have better retrieval than a subject shown someone else's gestures as cues.

It is further predicted that self-generated gestures will function as effective cues for their associated lexical target at both an immediate retrieval interval and across a delayed retrieval interval. The degree of retention or forgetting between the immediate and the delayed retrieval interval should be a function of how well the cue specifies the target so that there should be greater retention of words with iconic or metaphoric gestures and greater forgetting of words with less meaningful gestures.

The secondary questions of importance are the issues of whether concreteness of the target words and the verbal ability of the subject are related to gesture use. It is predicted that a meaningful gesture will serve as an effective cue for recall for both abstract and concrete words and that subjects with high verbal skills will not only produce more gestures than subjects with low verbal skills, but will benefit from the cueing of gestures more than low verbal skilled subjects.

Testing of these predictions occurred by looking at gestures as cues for lexical retrieval. Subjects in the present study were given a series of abstract and concrete words and asked to explain the meaning of each item. Pilot work indicated that subjects would spontaneously produce gestures during this task even without specific instructions for gestural use. Each subject was videotaped for cueing and scoring purposes. Following task performance, half the subjects were given an immediate recall test, and then asked to return in 2 weeks at which time they were given a second recall test (Immediate-delayed group [I-D]). The remaining half of the subjects were also asked to return in 2 weeks at which time they were given their first recall test (Delayed only group [DO]). In this way, the question of cue effectiveness over long retention intervals can be viewed. Not only will there be a baseline measurement for the immediate effect of gestures on memory, but a measurement of how much may be lost over a two week period. In addition, by adding the DO group, the ability of gestures to consistently cue a lexical target can be assessed. In other words, if gestures serve as effective cues for memory at the immediate retrieval interval, but not at the delayed retrieval interval, then it can be concluded that gestures do not distinctively specify the memory event in any consistent way over time. If however, gestures do serve as effective retrieval cues at both retrieval intervals, then it would seem that hand gestures are a good cue for the lexical event across time. By adding the DO group, there is additional evidence that the cue is or is not a distinctive cue that remains unchanged over time. If the subjects in the DO group have the same level of recall as the subjects in the ID group at time two, then a practice effect of cueing can be eliminated and gestures can be assumed to be a constant part of the cue environment.

In order to address the question of gesture specificity to the producer three cueing environments were used in this study. The first was Self-cued [SC] where subjects were cued with their own gesture production during recall. The second was the other-cued [OC] group where subjects were cued with gestures that were produced by another subject in the SC group. Finally, the no-cue [NC] group was not shown any gestures during their recall. Half of the subjects in each cueing condition received the immediate-delayed recall condition and half received the 2-week delayed-only recall test, for a total of six subject groups altogether.

From this manipulation the differences between the effects of self-generated cues on recall versus the effects of cueing with someone else's gestures should be clear. However, cueing with another person's gestures could serve as a tool for general facilitation of item recall due to the gesture functioning as an imageable cue for the target. In other words, a gesture could specify the target word so well that anyone viewing the gesture might be able to guess the word without having any prior experience with either the word or the descriptive production of the word. This effect could result in an obvious problem in that recall of the OC group could be due to subjects using the imageable gestures as visual cues for recall rather than actually being cued for recall. In order to determine the possibility of this happening, a pilot study was performed where subjects who were unfamiliar with the target words were asked to view a videotape of the gesture illustration and to guess what words were being described. This was done in order to ensure that gestures were not interpretable by anyone other than a person who had produced them. Subjects in the pilot study were unable to guess any of the presented words. This is consistent with findings by Feyereisen, Van de Wiele, and Dubois (1988) where it was demonstrated that subjects were unable to choose the correct verbal interpretation in a multiple-choice task for a series of gestural enactments. Thus, any facilitation of recall by the OC group should be due to the similarity in gesture production by the other person to their own production.

Chapter II

Experiment 1

Method

Subjects. The subjects were 96 undergraduates (30 males, and 66 females) who participated in the experiment to fulfill a course requirement.

Material. There were forty items or concepts designated as target words. The words were selected on the basis of their concreteness and imagery ratings, with 20 words having high ratings (concrete words) and 20 words with low ratings (abstract words). The mean imagery and concreteness rating were 3.9, 2.9 for the abstract words and 6.5, 6.8 for the concrete words (Paivio, Yuille, & Madigan, 1968).

Design. A 3 X 2 X 2 X 2 design was used in this study. The between-subjects variables were cue environment (self-generated cue [SC], other-generated cue [OC], and no cue [NC]), retrieval interval (immediate and delay [ID], delay only [DO]) and SAT verbal scores (high and low). The within-subjects variable was word type (abstract, concrete). The dependent variables were the number of gestures used, the type of gestures used (meaningful, and nonmeaningful), and the number of words recalled.

Procedure. SAT verbal scores were collected for all subjects prior to testing. A median split of the scores was used to divide the subjects into high and low verbal skill groups. A third of the subjects at each level of verbal skill was randomly assigned to one of the three cueing groups. Within each cueing group, half of the high and half of the low verbal skills subjects were randomly assigned to either the ID retrieval interval or to the DO retrieval interval group.

Subjects were tested individually and were not given a explanation for the purpose of the experiment. They were simply told that they would be given a series of words, one at a time, and they were asked to explain the meaning of each word. There were no suggestions to concerning gestures and the instructions were purposely vague. If subjects asked for further instructions, they were asked to describe each word so that someone else who was unfamiliar with the object or concept would be able to understand or recognize the word if they heard the subject's description. Subjects were further told not to worry about excluding the target word from their description, but just to say whatever they wished. Subjects were told that they had 35 seconds per word and to use all the time if possible. At no time were subjects instructed to use their hands to illustrate the words. Thus, gesture production was entirely a spontaneous process that accompanied the verbal output. All subjects were asked to stand during their descriptions and were told that they would be videotaped for scoring purposes. Each of the tape-recorded words was preceded by a beep and the number of the word. This was done in order for the experimenter to flash a white card in front of the videotape at the beginning of each description. Thus, during the cued recall test for self-cued and other-cued subjects, which was visual only with no auditory information, the experimenter could determine when each new word began and could inform the subject that the gesture production for a new word was beginning.

After the descriptions, the subjects in the ID retrieval groups (NC, SC, OC) were engaged in conversation by the experimenter for five minutes. Subjects in the NC group were then asked to recall as many of the words as possible in any order. They were given the same amount of time for recall as subjects in the cued groups which averaged about 20 minutes. If subjects said they were finished before that time they were told to continue trying and informed of how much time was left for their recall period. Thus, they were not allowed to terminate the session, but asked to remain until the 20 minutes was finished.

Subjects in SC group were shown their own video production of their descriptions without sound, and with their faces blocked out with tape. Gesture viewing was not prevented by the facial blocking as gestures were never performed in front of the face. This was to ensure that the only cues available were hand gestures. Subjects were instructed to try to determine which words they were describing from the gesture information. They were also told that if they remembered other words as they viewed the videotape that they should write them at the bottom of the page. Subjects were timed with a stopwatch for each word to determine at what point during the video presentation retrieval occurred. Once a word was cued the videotape was fast-forwarded to the next word. Subjects in the OC group were treated exactly the same except these subject were not shown their own gesture production, but rather, they were shown a production from the SC group. Each one of the 16 subjects in the OC group were yoked to one of the 16 subjects in the SC group and shown their video. Subjects were told that they would be seeing someone else describing the same words as they did and they were to try to determine which of the words was being described.

Subjects in both the SC and OC groups were also told that if they remembered any incidental words at the time of the cueing to write them at the bottom of the page. If they later recognized the gestural depiction of an incidental words that they had already recalled, they were told they could mark it out of the incidental column and put it in the cued column. These words that were not specifically cued but recalled incidentaly during cueing, were labeled "residual recall".

After viewing the video, subjects in both the SC and OC groups were told to take 5 minutes and write down any other words they could remember that they described. Subjects in all three groups returned in exactly two weeks from the first session and the same procedure as session 1 was repeated for a delayed recall test.

Subjects in the DO groups were treated exactly as the subjects in ID groups except that they were not given any recall tests during the first session. They were asked to make a second appointment and told that the experiment would be explained to them at that time. At the end of a two-week interval they were given a recall test in either the NC, SC, or OC testing conditions.

Scoring.

Recall Data. Data for the NC groups were a simple numerical count of the number of words recalled during a free recall test, either immediately and two-weeks later for the ID group or two-weeks later for the DO group. Thus, there was a score for the number of abstract words and the number of concrete words retrieved for the immediate retrieval interval and also for the delayed retrieval interval.

For the SC and OC groups there were two types of scoring, recall data and gesture data. The recall data included both a cued score and total recall. The number of words retrieved during the gesture viewing was considered to be the cued recall data. There was a score for the number of cued abstract words recalled at both the immediate and the delayed retrieval interval and a score for the number of cued concrete words recalled at both the immediate and delayed retrieval iterval. In addition, there was a total score which consisted of the total number of cued plus residual words recalled for both the abstract and concrete words at both the immediate and delayed retrieval intervals.

Subjects in the SC and OC groups were asked at the end of the test to free recall any additional words not remembered during the cueing session, but only two subjects remembered more than two additional words.

Gesture Scoring. A transparent grid with one-inch squares was placed over the television monitor. Every subject had a spontaneous position that they naturally rested their hands between descriptions. This position was usually different for each subject, but each of the subjects was generally consistent about returning their hands to the location after each verbal description. This position was noted as a home base and movement within that grid was generally minimal. Any movement outside of the home grid was considered a gesture and scored as such by each rater.

Gestures were first categorized into three categories, illustrators, body-focused movements, and vague gestures. Illustrators included both iconic and metaphoric gestures as described by McNeill, (1985). Body-focused movements were identified according to those descriptions provided by Freedman (1972). The vague gesture included any hand movement that seemed less directive and less expressive of the verbal content, such as a shrug with the hands, a 'beat' (McNeill & Levy,1982), a wave with the whole arm, or a gesture that seemed devoid of semantic content.

Each word that was described was scored for the number of gestures produced for each of the three categories of gestures. The inclusion of each gesture into one of the three categories was used exclusively for determining whether a meaningful gesture was likely to aid retrieval at time of cueing. Thus, for each word that was cued, if an illustrator gesture was produced prior to, or at the time of cued recall, then the word was said to be cued by a meaningful gesture. If at the time of cued recall no meaningful gesture had occurred, but rather the word was cued by a vague or body-focused gesture, then the word was categorized as being cued by a nonmeaningful gesture. If a word was not cued, but rather a residual recall, then the word was categorized as being accompanied by a meaningful or nonmeaningful depending on whether there was a greater number of illustrators produced during the description or if there were more vague or body-focused gestures produced during the description. If the number of illustrator gestures was greater than the number of vague or body-focused gestures produced throughout the description the word was considered to be categorized by meaningful gestures. If the number of body-focused or vague gestures was greater than the number of illustrators, then the word was considered to be categorized by nonmeaningful gestures. If no gestures were used for a target word, then the word was considered to be included in the nonmeaningful category. Thus, each subject had a score representing the number of words recalled that were accompanied by a meaningful gesture, and a score representing the number of words recalled that were accompanied by a nonmeaningful gesture for both cued and total (cued plus residual) words recalled. There were three independent judges of gesture categorization with an interrater reliability of R=0.92.

Chapter III

Results.

Recall Scores for Immediate/Delayed (ID) Groups. Recall scores were calculated for each subject. Recall scores for the SC and OC groups consisted of the number of cued words recalled, as well as the total number of words recalled (cued plus residual). The recall scores for the NC group consisted of the total number of words retrieved at the time of free recall. Table 1 presents the means for the total number of words recalled by the ID groups as a function of SAT and abstract and concrete word type at both immediate and delayed retrieval intervals. A repeated measures ANOVA revealed an effect of cue conditions, $F(2,42) = 27.5$, $p < .01$); SAT $F(1, 42) = 4.80$, $p < .05$); Interval $F(1,42) = 181.47$, $p < .01$); and Word type $F(1,42) = 58.36$, $p < .01$. There were no significant interactions. As predicted, the SCID group recalled more words, both abstract and concrete, and across both the immediate and the delayed retrieval intervals than did the NC or SC groups.

For SAT differences, post hoc tests revealed that at the immediate retrieval interval the SC group, both low and high SAT, was significantly different from both of the NC groups and the low OC group for both word types, but not significantly different from the high SAT OC group. At the delayed interval, both the low and high SAT SC group was significantly different from both the NC and OC groups at both levels of SAT. There were no differences between the NC and OC groups.

Table 1

Mean number of abstract and concrete words recalled by the NC, SC, and OC groups at immediate and delayed retrieval intervals as a function of SAT.

	Retrieval Interval					
	Immediate			Delayed		
Word Type	Abst	Conc	Total	Abst	Conc	Total
Condition						
NCID						
LOW SAT	8.75	10.38	19.12	3.37	5.25	8.61
HIGH SAT	7.88	11.38	19.25	4.75	7.62	12.37
SCID						
LOW SAT	11.50	14.50	26.01	7.38	10.88	18.25
HIGH SAT	10.25	15.50	25.75	6.62	13.00	19.63
OCID						
LOW SAT	7.85	10.38	18.25	3.25	6.38	9.61
HIGH SAT	10.12	12.62	22.75	4.62	7.50	12.12

Note: For the SC and OC groups this recall reflects total (cued and residual) words recalled.

Total and Cued Recall Comparisons for SC and OC Groups Only. In order to address the question of the effects of self-generated cueing on recall, an analysis was performed comparing just the SC and the OC groups for total (cued and residual) recall and then cued recall only, without the effects of SAT or word type. For the total number of words recalled, an ANOVA revealed an effect of Cue Condition ($F(1,30) = 42.15$, $p < .01$); Interval ($F(1,30) = 109.6$, $p < .01$); and an interaction of Condition X Interval that was marginally significant (F $(1,30) = 2.89$, $p < .10$. Recall was better for the SC group than the OC group at both retrieval intervals (see Table 2). For cued recall only, a repeated-measures analysis showed that the SC group remembered significantly more cued words than the OC group at the immediate retrieval ($F(1,30) = 19.92$, $p < .01$), and at the delayed retrieval ($F(1,30) = 24.56$, $p < .01$).

Table 2

Mean number of cued-only and total (cued plus residual) recalled by the SC and OC groups at both retrieval intervals.

	Immediate		Delayed	
Recall	Cued	Total	Cued	Total
SCID	15.1	25.9	13.9	18.9
OCID	8.8	20.5	5.9	10.9

Recall of Incubation and Hypermnesia Words for SCID . Some words that were recalled during the immediate retrieval period were, of course, not recalled at the delayed retrieval interval. In order to view both the consistencies and deviations in the patterns of recall from the immediate retrieval interval to the delayed retrieval interval, further analysis was done. Table 3 presents the number of cued and residual words recalled at the immediate and the delayed retrieval interval. As can be seen, 74% of the cued words remained consistently cued over the two-week retrieval interval while only 22% of the residual words remained consistent. In addition, there were .06 percent of the residual words that were considered hypermnesia as they were recalled at the delayed interval, but not the immediate retrieval interval (Erdelyi & Becker, 1974). Finally, the data indicate a gestural incubation effect where 18% of the words that were recalled residually at the immediate retrieval interval then became gesture cued at the two-week interval.

Table 3

Cued and residual recall scores for the SCID group at both immediate and delayed retrieval intervals.

	Cued	Residual	Consistent		Hypermnesia	Incubation
			Cued	Residual		
Immediate	15.1	10.8				
Delayed	13.9	5.1	11.1	2.4	0.94	1.9

Note: Consistent category is the mean number of words that remained cued or residual consistently from the immediate to the delayed retrieval interval. Hypermnesia category consists of the mean number of words that were recalled at the delayed retrieval interval, but not the immediate retrieval interval. Incubation category consist of the mean number of words that were cued by a gesture at the delayed retrieval interval out of the number of words that had been residual recall at the immediate recall.

Recall Scores for the Delayed Only (DO) Groups. Recall scores were calculated for subjects in the DO conditions, again with free recall for the NC group and the total (cued plus residual) recall for the SC and OC conditions. Means for the NCDO, SCDO, and OCDO conditions were 8.9, 15.4, and 8.8, respectively. An ANOVA revealed that subjects recalled significantly more words in the SC condition than in the OC or NC groups, $F(2,45) = 10.89$, $p < .01$, while the NC and the OC groups were not significantly different from each other.

<u>Comparison of ID to DO Groups at the Two-week Recall.</u> The purpose of comparing the ID groups to the DO groups was twofold. First, it was important to establish that gesture cues are consistent over time to the producer without prior exposure to the gestures. Secondly, it was important to rule out the possibility that the SCID group maintained a high rate of recall over the two-week period due to a practice effect of a prior recall test.

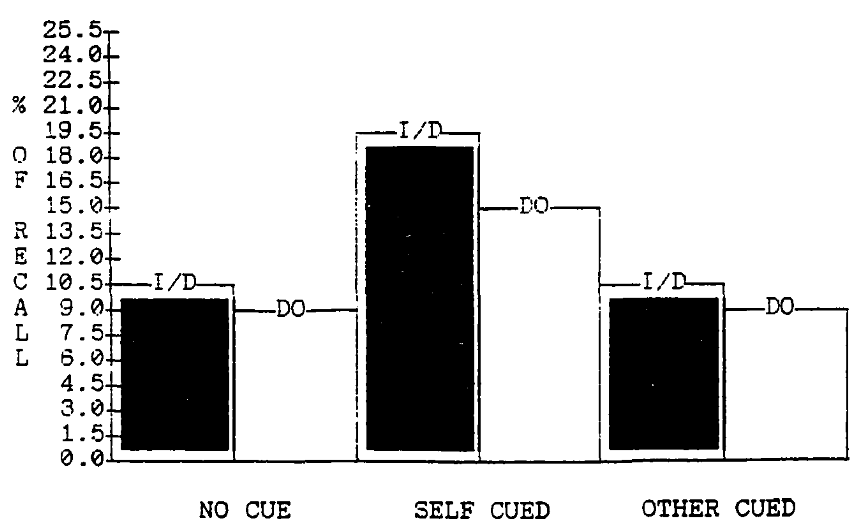
Figure 1 presents the recall scores of all six groups at the delayed retrieval interval. An ANOVA revealed that subjects in the SC group, whether ID or DO, recalled significantly more words than any of the other groups, $F(5,90) = 14.16$, $\underline{p} < .01$, and a planned comparison test showed that the SCID group was not significantly different from the SCDO group, $\underline{p} > .10$. In addition, a t-test was calculated to determine if there were any differences between the ID and the DO groups due to a practice effect. Means for the (SC, OC, and NC) ID groups totaled 13.4 while the DO groups averaged 11.0

for a nonsignificant difference between the groups, ($t(94) = 0.67$, $p < 1$.

Although the DO groups did recall less words than the ID group over the two-week period, this difference was nonsignificant within each cueing group. In addition, the loss of recall by the DO group was the same for the no cue group as it was for the cued groups, indicating that it was not the cueing that was responsible for this decrease. Since, all further analyses revealed parallel results between the ID and DO groups, further discussion will be limited to the ID groups.

Figure 1.

Mean number of words recalled by the ID groups and the DO groups at the 2-week delayed retrieval interval.



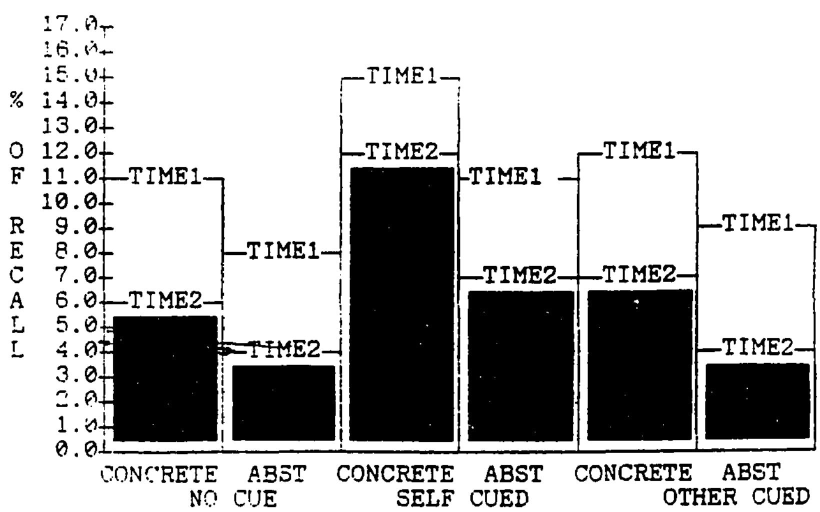
Note: For the SC and OC groups this recall reflects both cued and residual words recalled.

Recall Scores as a Function of Concreteness of the Target Word Type. As stated, gesture use and recall of words is sometimes a function of the word's imagability. Thus, in order to answer the question of the pattern of recall scores for both concrete and abstract words, analyses were calculated to view this recall as a function of gesture cueing. Means were collected for the number of abstract and concrete words that were recalled at both the immediate and the delayed retrieval interval. Figure 2 reveals the differences in recall for the groups at both the immediate (time 1) and delayed (time 2) retrieval intervals as a function of word type. Recall for the NCID group was the number of words retrieved at the free recall session, and recall for the SCID and OCID groups was the total recall (cued plus residual words).

A repeated measures ANOVA revealed a significant effect of Condition ($F(2,45) = 25.50$, $p < .01$), Interval ($F(1,45) = 176.67$, $p < .01$), Word type ($F(1,45) = 57.11$, $p < .01$), and a nonsignificant interaction of Condition X Word type. Planned comparisons showed the SCID group to be significantly different from both the NCID and the OCID group on the number of concrete words retrieved at both the immediate retrieval interval ($F(2,45) = 13.81$, $p < .01$), and the delayed retrieval interval ($F(2, 45) = 15.57$, $p < .01$). However, in the number of abstract words retrieved, the SCID group was significantly different from the NCID and OCID groups only at the delayed retrieval interval ($F(2, 45) = 10.71$, $p < .01$). The NCID and the OCID groups were not significantly different from each other in word type at either retrieval interval.

Figure 2.

Differences in recall of NC, SC, and OC ID groups at the immediate retrieval interval (Time 1) and delayed retrieval interval (Time 2) as a function of abstract or concrete word types.



Note: For the SC and OC groups this recall reflects the total (cued and residual) words recalled.

<u>Comparison of SCID and OCID's Recall for Abstract and Concrete Words on Cued Recall Only.</u> Similar to the pattern of results in Figure 2, the SCID group

consistently retrieved and retained more abstract and concrete words than the OCID group even when considering just the cued words that were recalled without the residual words (see Table 4).

A repeated measures ANOVA revealed a significant difference between the two groups with Condition ($F(1,30) = 30.02$, $p < .01$), Interval ($F(1,30) = 7.33$, $p < .01$), and Word type ($F(1,30) = 57.96$, $p < .01$). There was also a significant interaction of Word type by Condition with ($F(1,30) = 7.38$, $p < .01$). Planned comparisons showed that the SC group retrieved significantly more concrete words than the OC group at both retrieval intervals, and more abstract words at the delayed interval.

Table 4

Mean number of cued words (no residual words) recalled by the SCID and OCID groups as a function of abstract of concrete word type.

		Retrieval Interval	
Condition		Immediate	Delayed
SC	ABSTRACT	4.38	4.1
	CONCRETE	10.8	9.8
OC	ABSTRACT	3.1	1.4
	CONCRETE	5.8	4.4

Recall Scores of ID Groups as a Function of SAT Scores. Further analysis was performed to see the pattern of recall as a function of SAT scores for each condition. Table 1 shows the mean number of total words recalled by all the ID groups at both immediate and delayed retrieval intervals. A repeated measures ANOVA revealed a significant effect of Condition, $F(2,42) = 26.60$, $p < .01$, and Interval, $F(1,42) = 183.2$, $p < .01$, but not for SAT $F(1,42) = 1.70$, $p > .05$, nor an Interval X SAT interaction, $F(2,42) = 1.60$, $p > .05$.

Table 5

Mean number of cued-only words recalled by the SC and OC groups at immediate and delayed retrieval intervals as a function of SAT.

	Retrieval Interval	
Condition	Immediate	Delayed
SCID		
LOW SAT	14.1	12.1
HIGH SAT	16.1	15.6
OCID		
LOW SAT	8.8	4.9
HIGH SAT	8.9	6.9

Comparison of Cued Recall of SC and OC Groups as a Function of SAT and Retrieval Interval. A somewhat different pattern emerged when viewing the differences in recall between the cued groups when looking at the cued recall only. Table 5 reveals that the SC high SAT group lost only an average of 0.5 words between retrieval intervals while the OC high SAT group lost an average of 2.0 words. The SC low SAT group also lost 2.0 words over the two-week interval, with the low OC group suffering the greatest loss in retention with 4.0 words. A repeated measures ANOVA revealed that the SC group, both high and low, was significantly different from the OC group, both high and low ($\underline{F}(1,28) = 30.54$, $\underline{p} < .01$), and at both retrieval intervals ($\underline{F}(1,28) = 7.18$, $\underline{p} = .01$).

Pattern of Gesture Use as a Function of SAT and Word Type. Since it was important to determine whether gesture use was different for subjects with different levels of verbal skill, the production of gestures was counted for each word. Each word was given a numerical count of the number of gestures, both meaningful and nonmeaningful, produced during the descriptions for each subject. The numerical count was calculated in order to determine a pattern for gesture use.

Not surprisingly, in the numerical count there was a greater number of meaningful gestures associated with the concrete words than the abstract words. For 90 percent of the concrete words there were more meaningful gestures used than nonmeaningful and in 58 percent of the abstract there were more meaningful gestures used than there were nonmeaningful. In addition, there were very few concrete words (less than 3 percent) where no gestures at all were produced during the description, but 16 percent of the abstract words were produced during the description phase without any gestures. In addition, there was a significant difference in gesture production between subjects with high and low SAT scores ($F(2,28) = 3.43$, $p < .05$). Post hoc tests revealed there was a significant difference between the groups for meaningful gesture use for concrete words, with high SAT producing more meaningful gestures ($M = 19.5$) than low SAT subjects ($M = 17.5$) with $F(1,14) = 7.0$, $p < .01$. Also, low SAT subjects had a significantly greater number of concrete words ($M = 1.37$) and abstract words ($M = 5.25$) with no gesture use than did high SAT for either concrete ($M = 0.1$) or abstract words ($M = 1.25$), with $F(1,14) = 5.93$, $p < .01$.

Table 6

The mean number of cued-only abstract and concrete words recalled by the SC high and low SAT subjects.

	Retrieval Interval			
	Immediate		Delayed	
Word Type	Abstract	Concrete	Abstract	Concrete
SAT				
LOW	4.37	9.75	4.12	8.00
HIGH	4.38	11.75	4.14	11.50

Since it is predicted that recall is a function of verbal skills, word imagery and gesture cueing it is important to look at the differences between recall for the low and high SC group. Table 6 shows the number of cued words recalled as a function of concreteness and SAT scores. An ANOVA reveals no significant differences between SAT ($\underline{F}(1,14) = 2.76$, $\underline{p} > .05$); or interval ($\underline{F}(1,14) = 1.04$, $\underline{p} > .05$); but word type was significant with $\underline{F}(1,14) = 49.40$, $\underline{p} < .01$. In addition, there were no significant interactions.

Conditional Probability of Recall for Abstract and Concrete Words Given a Meaningful Gesture Production.

Each word was categorized as being accompanied by meaningful or nonmeaningful gestures depending on whether a meaningful gesture had been produced prior to, or at the point of cued recall. The categorization was used to determine the type of gesture used to activate retrieval for cued recall. Thus, scores could be calculated to determine the probability of recall as a function of whether a meaningful gesture was produced or not. These results show that between abstract and concrete words that were accompanied by a meaningful gesture, there was a significantly higher probability for recall of cued concrete words than for recall of cued abstract words, ($t(15) = 3.56$, $p = .03$). However, this advantage for recall of concrete words disappeared when considering the cued-plus-residual recall, because when the residual words were included, there were no significant differences between recall of the abstract words and concrete word when they were accompanied with a meaningful gestures, ($t(15) = 1.78$, $p > 1$. Table 7 shows the percentages of recall for each category. As there were large differences in the percentages of words recalled with a meaningful gesture and words without a meaningful gesture, it was not unexpected that a paired t-test revealed a significant difference between recall of words with a meaningful gesture and recall without a meaningful gesture for abstract, ($t(15) = 5.87$, $p < .01$), and also for concrete words ($t(15) =7.19$, $p < .01$). These results indicate that words with a meaningful gesture were more likely to be remembered even if they were not retrieved at the exact time of the cue.

Table 7

The conditional probability of recall of cued and total (cued plus residual) words as a function of whether a meaningful gesture was produced with the word.

Recall	Cued			Total (Cued + Residual)		
	Abst	Conc	Total	Abst	Conc	Total
WMG	0.36	0.56	0.48	0.66	0.75	0.73
W/O GES	0.07	0.09	0.07	0.40	0.08	0.39

WMG= With meaningful gesture
W/O GES = Without meaningful gesture

CHAPTER IV

DISCUSSION

The results of Experiment 1 showed that subjects that were cued with their own gesture production performed significantly better on a recall test than those subjects without any cueing or subjects who were cued with someone else's gesture production. This facilitation for recall from self-generated gesture cues was consistent for both abstract and concrete words, across high and low SAT scores and across a retention interval of two weeks. In fact, when considering only the words that were retrieved as a function of gesture cueing (cued recall only), the low SAT subjects only declined by an average of two words over the two week period, and the high SAT lost less than 0.6 words (see Table 5), with an overall loss for the SC group of 1.2 words (see Table 2).

Consistent with the above pattern, subjects in the delayed- only group that were cued with self-generated gestures recalled more target words than the NCDO or SCDO groups, and recalled only slightly fewer words than did subjects in the SCID group who had a prior recall test. This suggests that self-generated gestures serve as distinctive cues for retrieval of an event and aid in recall even after long retention intervals. Importantly, no differences in recall are found between the NC and OC groups. This indicates that the groups that received someone else's gestures for cues did not gain any information that facilitated retrieval of the word. Thus, the gesture was specific to the person who produced it.

The sole exception to this pattern occurred for high SAT subjects recalling abstract words; in this case the OC group was not significantly different from the SC group at the immediate retrieval interval, and was superior to the NC group. This seems to indicate that subjects with higher SAT scores did gain from viewing someone else's gestures at the time of production particularly for abstract words. This advantage disappears however, by the second recall test and scores for the OC high SAT subjects parallel those scores for the NC group. In fact, when considering cued recall only, the OC group for both SAT groups was cued on an average of 3.1 words at the immediate retrieval interval for abstract words, but this facilitation decreased to 1.4 by the delayed retrieval interval. Thus, it seems that viewing someone else's gestures for abstract words was sufficient to prime for the target word at immediate retrieval, but the usefulness of the gesture as a cue was not consistent over time.

Conversely, the SC group gained an obvious advantage by viewing their own gestures and this performance remained constant over the two-week retrieval interval. In viewing the pattern of gesture cueing for the SC group it is not surprising that there is a higher rate of retrieval during the cueing phase for concrete words than for abstract words. A gesture used for concrete words is usually iconic and therefore generally specifies the lexical item for recall. In other words, an iconic gesture contains sufficient enough retrieval information either to activate immediate lexical recall or to constrain a search process that would result in quick retrieval of the target word. Thus, there would be a higher rate of retrieval during the cueing phase for concrete words than for abstract words. For example, Table 7 shows that in cued recall only, concrete words with a meaningful gesture were better remembered than abstract words with a meaningful gesture (56% of concrete words were recalled while only 36% of the abstract words were recalled). In addition, in cued recall, the percentage of abstract and concrete words without a meaningful gesture were recalled equally poorly (7% abstract and 9% concrete). To summarize, for immediate recall concrete words cued with a meaningful gesture were more likely to be recalled than abstract words with a meaningful gesture, but concrete and abstract words had an equal probability of recall when the gesture was not meaningful.

However, this pattern was different when considering residual recall. In residual recall, abstract words that were accompanied by a meaningful gesture were only slightly less likely to be retrieved than concrete words that were accompanied by a meaningful gesture (see Table 7). Abstract words with a meaningful gesture were recalled 66% of the time, while 75% of the concrete words were recalled (t (15) = 1.78, $p > .05$). Yet, abstract words not accompanied by a meaningful gesture were more likely to be recalled than concrete words without a meaningful gesture (40% of abstract words versus 8% of the concrete words). Some retrieval of uncued words can be expected, but such a degree of inequality between word types was surprising.

One explanation for such a high rate of residual recall for abstract words is that some form of cueing is occurring but the effect is too slow to affect immediate recall. This suggests that if the gesture is vague and did not explicitly constrain the lexical retrieval, then the search process takes longer but does occur at a later time. When these rates of recall are further analyzed, the 33% rate of residual recall for abstract words without meaningful gesture accompaniment can be further delineated into either words with vague gestures or words that had no gesture at all. In this case, the probability of recall was considerably higher for abstract words with vague gestures (27%) than for abstract words with no gestures (14%). Vague gestures that accompany abstract words are possibly insufficient for immediate activation of the target word, and in turn, the semantic activation might be broader which would require more search time to meet the criterion for recall. For example, the gestures for the abstract word may activate a larger group of possible lexical targets and it would take more time to reject the incorrect targets and identify the correct word. Anecdotal evidence for this is the report by many subjects during gesture cueing of tip-of-the-tongue experiences indicating the activation of some trace-access (Nelson, Gerler, & Narens, 1984), but not a strong enough activation to produce immediate retrieval.

This effect could be viewed in terms of priming (Jacoby, 1983), incubation (Yanuv & Myer, 1987; Nelson et al (1984); Posner, 1973), or perceptual semantic representations (Hirshman, Snodgrass, Mindes, & Feenan, 1990). Further evidence for the possibility of incubation effects is evident when viewing the differences in recall between the immediate retrieval interval and the delayed retrieval interval. During the immediate recall test there was a great percentage of words that were not recalled at the time of gesture cueing, but were later recalled as residual words. However, when the gesture production was shown at the delayed retrieval interval for these words, the gestures served as good retrieval cues and the words were immediately recalled. In fact, at the delayed retrieval interval, 18 percent of the words that were previously not recalled at the time of gesture cueing were then remembered at the time of cueing. This was in contrast to the .06 percent of hypermnesia words recalled at the delayed interval that had not been recalled, either cued or residual, at the immediate retrieval interval (Erdelyi & Becker, 1974). This suggests that the gesture becomes a more distinctive element of the memory trace without any explicit connection of the gesture with the word at the time of initial exposure. This is consistent with the position of Hirshman et al (1990) where they suggest that a perceptual search process using sensory and semantic information for identification of an item can be combined with a second, more elaborative search process, and that the components of the resultant memory trace become more highly associated through the process of conceptual priming.

In addition to the recall data, the pattern of gesture use as a function of SAT scores was an important finding. Consistent with the findings of Sousa-Poza and Rohrberg (1979), overall there were more meaningful gestures produced for the concrete words than the abstract words. High SAT subjects also produced more meaningful gestures for both concrete and abstract words than did subjects with low SAT scores. In fact, low SAT subjects had an average of 12 percent of the abstract words and 3 percent of the concrete words where there were no gestures produced at all. This seems to indicate that subjects with high verbal skills rely on gestural production as a component of speech processing more than subjects with lower verbal skills. However, when considering the effects of gestures as cues, the low SAT subjects recalled almost as many words as the high SAT group indicating that their gesture production served as an effective retrieval cue. This suggests that for the gestures that were produced by the students with low verbal skills they were just as proficient in using them for memory cues as were high SAT subjects, but differences in gesture production could have been responsible for the low SAT subject's lower recall rate.

Finally, there was one other finding of interest in Experiment 1. This concerns the recall of words at the time of cueing when there were no meaningful gestures associated with the word. Seven percent of the abstract words and 9% percent of the concrete words were correctly identified by the subjects in the SC groups at the time of cueing even though the accompanying gesture production appeared very nondescript. It is important to note that all of the words that were cued recall were accompanied by some motor or gestural movements. None of these words were scored as no gesture words. One interpretation of these findings is that even though the gesture appears vague and nonmeaningful to a objective rater, there may be information in these gestures that idiosyncratically represented the target to the subject. Thus, when viewing the gesture, the retrieval of the memory representation occurred in exactly the same way as it does when the gesture was very representative of the target item.

An alternative explanation for retrieval of target words during cueing when the target was not accompanied by a meaningful gesture is that there may be some degree of priming for recall due to an order effect. In other words, it may be possible that the serial presentation of the list of target words followed by the same serial order during cueing of the target words may have resulted in recall of words not due solely to the gesture cue for that word. Thus, Experiment 2 was designed to determine if this was the case.

In Experiment 2, subjects were given the same list order at generation as the subjects in Experiment 1.

After the initial generation phase, the subjects in Experiment 2 were asked to return in two weeks at which time they were given a cued recall test, again exactly as Experiment 1. However, at the time of the recall test, the videotapes had been edited so that gesture cueing was in a different order from input. In this way, if subjects were primed for recall due to the same serial order of study and test, then it could be predicted that subjects who experienced a change in the order of words from the time of gesture production to the time of gesture cueing should perform differently from subjects in the first experiment. However, if it were the case that cued recall was due specifically to gesture cueing, regardless of the input-output order, then subjects in Experiment 2 should perform no different than subjects in Experiment 1.

CHAPTER V

Experiment 2

Experiment 2 was designed to determine if the degree of recall by the SC groups in Experiment 1 was a result of order effects of list presentation. In other words, did subjects in the SC groups experience a recall advantage because the word list at presentation was in the same order as the word list at the time of gesture cueing. Thus, recall of one word would prime the subject for the next upcoming word and would require a reduction in gesture information or no gesture information in order to recall the word. Thus, it was necessary to test for this effect in order to determine whether it was the gesture that was responsible for the recall facilitation. In Experiment 2, during the initial production phase subjects were presented with the same list of target words in the same order as subjects in Experiment 1, but during the gesture cueing phase the videotape of their production was edited so that the order of the list of words was different.

Method

Subjects. The subjects were 16 voluntary undergraduates (6 males, and 10 females) who had not participated in the experiment before.

Material. The stimulus materials were the same tape-recorded list of words used in Experiment I.

Procedure. Subjects were randomly assigned to the SC or OC groups (8 to each group), and were tested individually in sessions that lasted approximately 30 minutes. The procedure was the same as for the subjects in Experiment 1 in the delayed only (DO) condition. After the subjects finished their description of the words, they were asked to return in exactly two weeks for a second session. During the second session, subjects in the SC group were cued with their own videotape production of their descriptions, without sound and with their faces blocked out. In addition, the videotapes had been edited so that the individual word descriptions were not in the same order as they had been produced. Subjects were given the same recall instructions as in Experiment I.

Subjects assigned to the OC group were cued with the same gesture production as was shown to the OCDO subjects in Experiment I except that the order of cue presentation had also been altered. Again recall instructions remained the same as in Experiment I.

CHAPTER VI

Results.

Comparison of Recall Scores of SC and OC Groups. Recall scores were collected for both groups. Table 8 reveals the mean number of words recalled by the SC and OC groups of Experiment 2 (SCE2, OCE2). As expected, subjects in the SCE2 group recalled significantly more words than subjects in the OCE2 group, with t (15) = 2.12.

Table 8

Mean number of words recalled by SC and OC groups in Experiment 2 and the SCDO and OCDO groups in Experiment 1.

	Experiment 1		Experiment 2	
	SCE1	OCE1	SCE2	OCE2
Word Type				
Abstract	5.38	4.00	5.25	3.75
Concrete	9.88	6.38	8.75	6.50

Comparison of Recall Scores for the SC Groups of Experiment 1 and Experiment 2. A t-test was used to calculate any differences between the self-cued group in Experiment 2 (SCE2) and the SCDO group of Experiment 1. The test revealed no significant differences between the groups, (*t* (23) = .51, *p* = .62). Means for the two groups were 14.0 and 15.2 respectively for the total (cued plus residual) recall. Further analysis of the two groups failed to reveal any significant differences between abstract-concrete recall (*F* (1,22) = .29, *p* < 1), or abstract-concrete cued-only recall (*F* (1,22) = .46, *p* < 1).

Comparison of Recall Scores for the OC Groups of Experiment 1 and Experiment 2. A t-test was calculated to determine any differences between the OC groups of Experiment 1 and Experiment 2. As predicted, subjects in the OCE2 group were not significantly different from the subject in Experiment I, OCDO, who saw the same gesture cueing presentation as they did, but in an unaltered order presentation, (*t* (15) = .07, *p* < 1).

CHAPTER VII

DISCUSSION

The results of Experiment 2 showed that subjects in the self-cueing group recalled more words that subjects in the other-cueing groups regardless of the change in the order of the word list from study to test. This effect also remained robust when the recall was viewed as a function of abstract or concrete words. Further evidence that there was no facilitation of recall due to order effects is obvious when comparing the groups in Experiment II to the groups in Experiment I. Subjects in the self-cued groups for both experiments were very similar in their pattern of recall as were subjects in the other-cued groups for both experiments.

The results of Experiment II again demonstrate that cueing subjects with their own gestures facilitates recall of the target words and that cueing with someone else's gestures does little to aid recall.

CHAPTER VIII

GENERAL DISCUSSION

The present study examined the effects of using hand gestures as self-generated cues for recall of verbal material. The results of these two experiments confirm many of the original predictions and illustrate the gestural component of the cue environment. Both experiments revealed that subjects cued with their own hand gestures recalled more words than subjects with no gesture cueing or subjects cued with someone else's hand gestures. The facilitation of recall due to gesture cueing remained consistent over a two-week period and in some cases resulted in an incubation effect for words not previously cued by gesture viewing. In addition, these experiment showed that gesture cueing resulted in better memory performance for concrete than for abstract words, but that gestures for abstract words produced priming effects so that recall for abstract words approached that of concrete words at the time of residual recall. Moreover, in cued recall only, abstract words with meaningful gestures were almost as well remembered as concrete words with a meaningful gesture. Likewise, Experiment II revealed that the facilitation of gesture cueing was constant over time and order change.

As stated earlier, the purpose of this experiment was to view gestures as cues for verbal information regardless of whether the gesture cueing was a function of episodic or semantic memory. In addition, this experiment did not approach this question directly, but in order to discuss the full effects of gestures as cues there were some episodic and semantic implications in the findings that need to be addressed. The basic problem concerning the episodic/semantic distinction is that of whether gestures served as effective cues for memory due to their semantic associations with the verbal target or because of the episodic encoding at the time of the verbal event. This issue is important because it has been proposed that gestures are semantic representations of the verbal target, but in the present study gestures are used in the context of an episodic memory task. Thus, the question arises as to whether viewing gestures results in better memory because gestures are episodic cues or because they are semantic associations with the target words. Tulving (1984) states that episodic memory is a system which processes temporal and spatial information about events or episodes. Semantic memory concerns itself with language and verbal symbols, particularly the meaning and referential aspect of words. These two systems are usually interdependent with much overlap and interaction but not necessarily always so. Tulving states that recalling the contents of an event does not necessarily predict recall of the event itself. Thus indicating that knowing what the gesture represented and using that as a cue to retrieve the verbal event does not predict recall of the episode itself.

There are findings in this study that suggest that the facilitation of recall due to gesture cueing could be due to semantic memory effects. For example, given the pattern of data that illustrates the priming effects of abstract words, where residual retrieval of abstract words approaches the percentage of recall for concrete words, one might argue that this supports the semantic interpretation of gesture cueing because priming is not an episodic phenomena. The semantic interpretation is also supported if one considers that words with a meaningful gesture are better recalled than words without a meaningful gestures, implying that the meaningful gestures generally specify the target words very well and might allow for an element of idiosyncratic guessing. Thus, gestures operating from the semantic memory system might evoke a free association to the target word rather than a specific cue memory as would be the case in episodic memory. In addition, the findings concerning incubation and hypermnesia tend to suggest that gestures function within the semantic memory system since the recall emerges as a context independent phenomena.

The suggestion that gesture cueing is a result of tapping into the semantic memory system is also consistent with the results from the self-cued delayed-only groups in Experiment 1 and Experiment 2 compared to the self-cued group in Experiment 1. If one assumes that gesture cueing is an episodic effect, then the prediction would be that the episodes of encoding the gestures as a cue for retrieval at both the production phase and the first testing phase would result in a stronger engram due to recoding and thus result in greater cue facilitation than those subjects that had no prior experience except at production, i.e. the self-cued delayed-only groups would not perform as well as the self-cued immediate and delayed group. However, in viewing the data the delayed-only groups were not significantly different from the self-cued group in Experiment 1. Once again this would indicate that the cues were not operating specifically as a function of the episodic memory system.

In addition, there was very little decline in the number of words recalled over the two-week period in the SCID group where as stated, there was only a decline of

1.2 cued words from the immediate retrieval interval to the delayed retrieval interval. If cueing with gestures were purely an episodic phenomena, then forgetting would have occurred, as forgetting is one of the characteristics of episodic memory. Thus, due to such a small decline it would seem that gestures were again a function of the semantic memory system. However, in looking at the data in a different way it is evident that more than 1.2 words were forgotten over the two-week period. Table 3 reveals that out of the 15.1 cued words recalled at the immediate retrieval interval and the 13.9 recalled at the delayed retrieval interval, only 11.1 of those words were consistently cued over the two-weeks, actually producing an average of 4 words out of 15.1 forgotten. The additional 2.8 words that were considered cued were the hypermnesia or incubation words that were either not recalled at all during the immediate retrieval interval or they were residual words. Thus, this seems to indicate that not all of the effects of gesture cueing are due to semantic memory but there seems to be some element of episodic memory involved. Supporting the episodic interpretation is the fact that there were less than 1% of incorrect target retrievals whereby the word retrieved was an associate to the target word and not the exact word itself. If gesture cueing were functioning entirely from the semantic representation, then one would expect more target intrusions. Since the majority of the words retrieved were specific to the encoded event, this would indicate an episodic influence on the retrieval event.

Thus, it is not clear which memory system is functional during gesture cueing. There seems to be evidence that supports both positions. One possibility could be that an interaction effect of the semantic and episodic memory systems could be occurring. From the present experiment, it would not be possible to answer this question. Further research focused towards more specific questions in this area would be necessary to clarify this issue. However, if the interaction effect could be viewed in terms of the present experiment, then the present findings can be explained in terms of both encoding specificity and semantic elaboration.

One explanation for the benefits of gestural cueing could be that gestures aid memory because they serve as an imageable cue for the verbal target and therefore this would explain why concrete words have an advantage over abstract words at retrieval. However, deference to an imagery explanation per se does not address all of the findings that this experiment revealed.

The primary finding of this experiment is that self-generated gestures do serve to cue retrieval of target words and these gesture cues remain consistent over a long retrieval interval. Since the cue consistently serves as an effective retrieval cue, it seems likely that gestural enactment is a distinctive cue that symbolizes the producer's memory representation of the event. This does not rule out the imagery aspect of the gesture cue, but since all of the gesture cues are not pure pictorial enactments of the target words, it seems likely that the gesture taps into additional processes other than imagery. In other words, abstract words with a meaningful but not necessarily a pictorial gesture, approach the recall rate of concrete words. If imagery is the only reason that these words are cued, then the imagery values would necessarily have to be the same for both word types. Since they are not the same, as concrete words have more iconic gestures and abstract words have more metaphoric and vague gestures, it seems reasonable to conclude that gesture viewing taps into other types of processing, and it also seems reasonable to conclude that these processes were activated at the production stage of gesture use.

One of the additional processes that hand gestures might utilize could be that of elaboration. Gesture movements must necessarily fluctuate on the number of semantic features that they can depict depending on the word's attributes that can be described. Hence, the greater number of semantic features, the greater degree of elaboration. The greater elaborateness of the gestural enactment at the time of encoding should predict the greater likelihood of retrieval. Craik and Tulving (1975) propose that the elaborateness of the original encoding event predicts that the critical number of cognitive features necessary for retrieval will be activated at recall. Since hand gestures are some form of semantic representation of the event, it seems clear that they must activate the type of elaborative processes associated with semantic memory. This type of elaborative memory-organizing process aids retrieval by bonding an association of the target item with other types of semantic representations (Graf & Mandler,1984; Graf, Mandler, & Haden, 1982; Graf & Ryan (1990). In the case of self-generated hand gestures, the motoric or imageable component of the memory trace is likely bonded with the target word as a part of the semantic representation of that word and is automatically encoded at the specific time of the verbal description of the target word. In terms of Tulving's (1982) model of retrieval, a synergistic ecphory of the memory trace occurs as a function of the original encoding event and the final retrieval environment. At the time of cueing, it is possible that a self-generated cue environment selectively activates the appropriate elaborative processes that facilitates recall of the target material, whereas the same cue environment that is not self-generated fails to tap into the same degree of elaborative processing. Thus, subjects that were cued with gestures not their own do not experience the same degree of reprocessing that subjects cued with their own gestures do.

A second issue concerning the differential retrieval effects of abstract and concrete words also provides further evidence that the gesture serves as a unique cue that specifies the memory and is not necessarily just an imagery cue. The results of this experiment demonstrate that in total recall abstract words with meaningful gestures are almost as likely to be retrieved as concrete words with gestures. If gestures were primarily an imagery cue, then there would always be a greater advantage for the more imageable concrete word. The present experiment demonstrates that both abstract and concrete words are remembered equally well, but concrete words are more likely to be retrieved at the time of immediate cueing and abstract words have a more residual retrieval. This suggests that gesture cues are unique for both word types, but that the concrete cue constrains the search size for quicker retrieval.

Again these results can be described in terms of Tulving's model of retrieval, whereas the gestures for the concrete words provides an immediate overlap of encoding and retrieval features and the conversion surpasses the naming threshold very quickly. The abstract words, however, are not associated with the same quality of semantic cues and are at first not sufficient for recall. However, information in the gesture cue continues to be processed or recoded until the resultant ecphoric bundle reaches the naming threshold. Thus, concrete cues have a greater quality of retrieval information and quickly result in reaching the naming threshold. Gesture cues for abstract words prime the memory trace but the process of ecphory for these words requires more time and results in residual recall.

In conclusion, hand gestures do very likely have an imagery component attached to their production. However, they also represent other aspects of the memory trace and are more likely produced as an automatic "spillover" of the cognitive processing taking place during encoding and production of speech. Since they are produced spontaneously they likely have a function in information-processing activities. One point illustrating the unintentional automatic production of gestures is that in the present study when subjects were asked whether they were aware of using these hand gestures during their verbal production they reported that they were not. Thus, gesture cues are the spontaneous production of unique cues for memory and are one way of overtly viewing the information-processing activity of the producer. At any rate, self-generated hand gestures serve as effective retrieval cues for verbal information and they remain as consistent cues over time.

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APPENDIX A

WORD LIST

CONCRETE	ABSTRACT
ACCORDION	ANXIETY
ADDING MACHINE	CHAOS
HAMMER	COMEDY
HARMONICA	CREATION
HONEYCOMB	DEATH
GUILLOTINE	DEVELOPMENT
IGLOO	EGO
PAY PHONE BOOTH	ESSENCE
PUSH LAWN MOWER	ETERNAL
RECORD PLAYER	FLEXIBLE
STRAIGHT RAZOR	FRICTION
TRIPOD	GRAVITY
TOASTER	HIERARCHY
TUNING FORK	HORIZONTAL
TWEEZERS	ISOLATED
UMBRELLA	JOURNEY
VENDING MACHINE	LIMELIGHT
WINDMILL	LENGTH
WINDSHIELD WIPERS	TIME
WINDOW FAN	UNIVERSAL