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Gestural facilitation of confrontation naming in severe aphasia

Hanlon, Robert E., Ph.D.

City University of New York, 1988

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**GESTURAL FACILITATION OF CONFRONTATION
NAMING IN SEVERE APHASIA**

**by
ROBERT E. HANLON**

A dissertation submitted to the Graduate
Faculty in Psychology in partial fulfillment
of the requirements for the degree of
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of New York.

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This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

GESTURAL FACILITATION OF CONFRONTATION
NAMING IN SEVERE APHASIA

by

Robert E. Hanlon

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Some degree of naming deficit or word finding difficulty is common to all subtypes of aphasia and characterizes virtually all aphasics. In a number of studies that have examined the gestural disturbance in aphasia and the utility of gestural interventions in aphasia therapy, a variable degree of facilitation of verbalization during gestural activity has been reported. This study involved the examination of the effect of different types of self-generated, gestural activity on oral-verbal expression.

The intention of the study was to determine if certain unilateral gestural movements, produced simultaneously during attempts of naming to confrontation, would differentially affect the oral-verbal expressive capacity of aphasic patients. It was hypothesized that activation of the proximal motor system of the hemiplegic right arm in the execution of a communicative, but non-representational, pointing gesture, would have a facilitatory effect on naming ability.

Twenty-four aphasic patients, representing five aphasic subtypes, including Broca's, Transcortical Motor, Frontal Anomic, Global, and Wernicke's aphasics were assessed on three gesture/naming conditions: right-sided proximally-driven pointing gestures, left-sided proximally-driven pointing gestures, right-sided distal activation (clenching the fist). In the hemiplegic anterior aphasics the elicitation of brainstem reflexes, particularly the asymmetrical tonic neck reflex, served to "break up" the flexor synergy of the spastic hemiplegia, enabling those patients to approximate a directional pointing gesture.

The findings supported the hypothesis, indicating that pointing gestures produced through neuromotor activation of the proximal (shoulder) musculature of the right paralytic limb differentially facilitated naming performance in the collective anterior subgroup, comprised of the four anterior subtypes, but not in the Wernicke's aphasics. However, only the Broca's aphasics differed significantly from the Wernicke's patients, with regard to this differential effect on naming. These findings may be explained on the view that functional activation of the archaic proximal motor system of the hemiplegic limb, in the execution of a communicative gesture permits access to preliminary stages in the formative process of the anterior action microgeny, which ultimately emerges in vocal articulation.

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Chapter I

The Problem

Neuropsychological rehabilitation is a diverse and extensive component of the discipline of clinical neuropsychology. Yet, few comprehensive models (Luria, 1963; Ben-Yishay, 1980) of neuropsychological rehabilitation have been developed. Attempts to improve expressive language function and the general communicative capacity of individuals with severe aphasia resulting from cerebral vascular accident have taken many forms. Cognitive rehabilitation approaches have utilized the gestural modality, among others, in a supplemental or adjunctive capacity to try to facilitate functional communication skills.

Research in this area has examined aphasics' capacity for comprehension and expression of communicative gestures, as well as other nonverbal meaning-bearing elements. Recent contributions to this area of study include the differentiation among the subtypes of aphasia, with regard to gestural utilization (Glosser, Wiener, & Kaplan, 1986) and consideration of the theoretical basis of gestural communication (Feyereisen & Seron, 1982; Kimura, 1979). Therapeutic intervention strategies employing gestural techniques have also been developed (Helm-Estabrooks, Fitzpatrick, & Barresi, 1982).

Anomia or word finding difficulty represents a deficit which characterizes nearly all aphasics, to varying degrees of severity. This problem with word finding occurs in each of the subtypes of aphasia and is one of the most common residual deficits following the spontaneous recovery of other defects of the aphasia syndrome. Word finding disturbances become strikingly evident when assessed on the standard naming paradigm, visual confrontation naming. Anomic errors which arise from disruption in the naming process take a variety of forms. These include semantic and phonemic paraphasias, circumlocutions, perseverations, neologisms, phonemic attempts, in addition to complete lack of response.

A number of factors have been implicated as being integrally involved in affecting the naming capacity of aphasics. These include the frequency of word usage, the context within which the naming response is required, semantic category, the sensory modality through which naming stimuli are presented, and the inherent sensorimotor characteristics of stimuli, such as operativity (Gardner, 1973). Furthermore, various cuing techniques have been evaluated with regard to their effect on naming performance. These include phonemic, semantic, contextual, and gestural cues, among others, in addition to the examination of the effects of simultaneous combinations of different forms of cuing (Huntley, Pindzola, & Weldner, 1986).

The focus of research on the gestural modality, as it relates to the facilitation of communication skills in aphasia, has primarily involved the comprehension and expression of representational or symbolic manual gestures. Two opposing theoretical views exist on this issue. The fundamental difference between these views resides in the influence of apraxia and its relation to aphasia. On one side of this issue, the difficulty in both the expression and comprehension of manual gestures is considered to be an extension of a central or generalized communication disorder, predominantly manifest in aphasia. The opposing side considers the gestural disturbance of aphasics to be a disorder of purposeful movement, or apraxia, rather than an additional facet of a central symbolic or representational deficit. This view was originally elaborated by Liepmann (1905). Contemporary theorists in support of the former view include Duffy and Duffy (1981), while proponents of the latter view include Goodglass and Kaplan (1963) and Kimura (1974, 1982). Although apraxia is commonly observed in association with aphasia following left or dominant hemisphere lesions, there does not appear to be a direct relationship, with regard to severity, between apraxia and aphasia (Liepmann, 1905).

The incorporation of gestural activity in structured therapy programs developed for the treatment of severe aphasia has received gradually increasing support. Most

therapeutic approaches utilizing the gestural modality have only concentrated on training in the functional use of symbolic manual gestures. Other forms of gestural communication, such as pointing gestures which function to specify or locate a referent in space, and descriptive gestures (i.e. expansion-contraction movements) which indicate dimensionality warrant further investigation. In addition to the fact that reasonably well preserved gestural ability may improve the communicative capacity of aphasics, there is some evidence that pointing movements required in a task of nonverbal expression may intermittently result in the "spontaneous articulation" (Johannsen-Horbach, Cegla, Mager, Schempp, & Wallesch, 1985, p. 79) of verbal referents.

The purpose of the present study was to examine the efficacy of differential gestural facilitation of confrontation naming in severe aphasia. As mentioned, research on the gestural ability of aphasics has concentrated on representational gestures and pantomime. This ability is obviously dependent upon the utilization of motorically intact upper extremity function. Moreover, research in this area has virtually disregarded the incorporation of the hemiplegic limb in gestural techniques due to the characterization of hemiplegia as essentially nonfunctional. Nevertheless, the hemiplegic right arm of nonfluent (i.e., Broca's and Global) aphasics generally retains at least a minimal degree of intact motoric

function, particularly the proximal-axial muscle system of the shoulder. Even patients with dense spastic hemiplegia are typically capable of shoulder flexion and abduction within a limited range.

Brown, Leader, and Blum (1983) demonstrated that it was possible to train functional hemiplegic writing skills in globally aphasic, right hemiplegic patients, who were agraphic and apraxic with the left hand. It was hypothesized that functional activation (via writing) of the proximal and axial motor systems of the plegic side may provide access to preliminary levels of linguistic processing, in this neuropathological population. This position is based on a microgenetic model of cognition which holds that cognitive formation hierarchically traverses neuroanatomical layers and cognitive stages in a process which recapitulates the course of forebrain evolution (Brown, 1977).

Earlier neuropsychological theorists who elaborated microgenetic models in attempt to explain aphasic symptomatology included Pick (1931) and Werner (1956). Pick, in particular, presented an extensive analysis of the aphasias, in which he conceived of aphasic symptomatology as representing preliminary stages in the normal process of language formation. Moreover, Pick (1931) considered gesture language an additional volitional system of expression which both phylogenetically and ontogenetically preceded verbalization or speech, and which holds great

compensatory value. Werner (1956) viewed aphasia within a comparative developmental theory on which he delineated two fundamental assumptions:

First, the functions underlying abnormal behavior are in their essence not different from those underlying normal behavior. Second, any human activity such as perceiving, thinking, acting, etc., is an unfolding process, and this unfolding or "microgenesis" whether it takes seconds or hours or days, occurs in developmental sequence (p. 347).

On this view it was hypothesized that neuromotor activation of the proximal muscle system of the right hemiplegic arm of anterior nonfluent aphasics, in the production of a communicative gesture (i.e., pointing of the arm), might facilitate verbal expression. Specifically, it was hypothesized that the right-sided proximally generated gesture would differentially advance naming, relative to a comparable left-sided gesture, as well as distal activation of the right hand. Moreover, it was predicted that this facilitatory effect would be limited to aphasics who had suffered anterior brain damage resulting from a cerebrovascular accident (viz., Broca's and global aphasics), characterized by nonfluent speech, misarticulation, and hemiplegia. Aphasics of the Wernicke's subtype, resulting from temporal lobe lesions and characterized by fluent speech and intact motoric function, were not expected to benefit from this gestural activity.

A pilot study provided solid support for the contention that utilization of the right hemiplegic arm of

aphasics in a gross gestural technique differentially advances confrontation naming ability. The study was completed with seven severely aphasic patients who had sustained a single cerebral vascular accident of the left hemisphere. Five of these patients were Broca's aphasics, characterized by nonfluent speech, word finding difficulty, and dense right hemiplegia. Two of these patients were Wernicke's aphasics, characterized by fluent speech, anomia, auditory-verbal comprehension defect, and the absence of paralysis. Two other Broca's patients were unable to complete the procedure due to extreme flaccidity of the hemiplegic arm. The seven patients completing the study consisted of four males and three females, with a mean age of 61 and a mean of four years since onset.

The experimental procedure involved the comparison of naming accuracy across three independent gestural conditions. Condition A consisted of the production of a pointing gesture, or an approximation thereof, utilizing the proximal shoulder musculature of the right arm. Condition B was included as a control condition, to rule out the effects of general left hemisphere activation, and exclusively involved distal movement (finger flexion) of the right hand. Subjects were instructed to make a fist. Obviously, patients with severe hemiplegia may not be able to voluntarily flex their fingers. Nevertheless, even if they can not produce observable distal movement, flexor tension can ordinarily be palpated. Condition C consisted

of the production of a pointing gesture by the intact left arm. Subjects were instructed to gesture simultaneously while trying to name the stimulus items.

The naming stimuli consisted of 141 black and white photographs of common objects selected from the Photo Resource Kit (Modern Education Corporation, 1979). The stimuli consisted of items representing eight different semantic categories (food, animals, vehicles, clothing, tools, household objects, personal use objects, and furniture/appliances). Stimuli within semantic categories were matched on frequency across conditions. An equal number of items within each category was also established across conditions.

The pilot study results suggested that there is considerable utility in and therapeutic potential for the incorporation of gestural techniques with the hemiplegic arm, in attempts to facilitate oral naming in cases of severe aphasia. Among the nonfluent hemiplegic patients a 22.0 mean difference in percentage of naming accuracy was revealed between Condition A (right pointing gesture) and Condition C (left pointing gesture), in favor of the former. Surprisingly, the fluent patients also produced a 15.6 mean difference in percentage of accuracy between Conditions A and C in favor of Condition A. Performance levels on Condition B (right handed finger flexion) invariably fell somewhere between the two experimental conditions.

During the pilot study it was determined that elicitation of brain stem reflexes (i.e., asymmetrical tonic neck reflex and symmetrical tonic neck reflex) enabled those aphasics with dense spastic hemiplegia to approximate a pointing gesture. The supraspinal tonic neck reflexes are elicited by rotation of the head and flexion/extension of the neck. A change in position of the head in relation to the body stimulates the proprioceptors of the muscles of the neck. This results in the elicitation of the tonic postural reflexes in patients with severe neuropathology, specifically extensive cortical damage (Cailliet, 1980). The tonic neck reflexes, as well as the tonic labyrinthine reflexes were originally observed in decerebrate animals, but they may be readily utilized therapeutically, particularly in combination with neuromotor inhibition techniques.

The tonic neck reflexes produce specific changes in the distribution of muscle tone throughout the entire body. The asymmetrical tonic neck reflex (ATNR), which is normally observed in infants until approximately six months of age, was incorporated extensively with the hemiplegic patients. The ATNR is elicited by lateral rotation of the head. The side of the body toward which the head is rotated (side to which the face is turned) responds reflexively with an increase in extensor tone throughout both extremities on that side, although it is typically more obvious in the arm. The reciprocal response

involves an increase in flexor tone throughout the extremities of the other side (side to which the occiput is turned). The symmetrical tonic neck reflex (STNR), which was incorporated considerably less than the ATNR is elicited by flexion and/or extension of the neck.

These postural reflexes were incorporated in the experimental procedure, primarily to facilitate the production of a proximally driven pointing gesture by the hemiplegics. By positioning the naming stimuli at approximately a 60 degree angle to the right of the patient, lateral rotation of the head to the right was required in order to see the stimulus. This movement typically elicited the ATNR, which served to "break up" or inhibit the flexor synergy characteristic of spastic hemiplegics. The resultant increase in extensor tone in the hemiplegic limb helped to enable them to produce or at least approximate a pointing gesture. Additionally, it was suggested (J. Brown, personal communication, October, 1986) that trunk rotation might facilitate gestural production on the hemiplegic side in a manner similar to the effect of the ATNR. This proved to be the case in the most severely involved subjects and was incorporated accordingly. Similarly, Cailliet (1980) has noted that "many latent neuropsychologic pathways probably become activated by special techniques of therapy using sensory stimulation, basic reflexes, and repeated efforts, but

these remain to be documented, verified, and standardized for general use" (p. 2).

In addition to the phylogenetically based model of microgenesis, support for the contention that gestural activation may facilitate articulation is available from other evolution-oriented models. Kimura (1982) has suggested that the relationship between oral and manual apraxia in aphasics, specifically the imitation of sequential movements, whether meaningful or meaningless, reflects overlapping of "motor control systems" of the left hemisphere (p. 144). She has proposed that aphasia resulting from frontal and parietal lobe lesions may be a manifestation of this defective motor control, rather than a symbolic deficit.

Support for this view comes from the anthropological literature on the evolution of communication, which holds that language evolved from gestural origins (Hewes, 1973). This position is consistent with the findings of Lieberman (1975) on the relatively recent evolvement of vocalization (post-Neanderthal) and Dart (1949) on the comparatively early development of a right manual preference in the functional activity (wielding clubs) of *Australopithecus*. Based on such physical anthropological evidence, Hewes (1973), among others (Johannesson, 1950; Paget, 1963), contends that a manual system of communication, which probably developed when man first hunted in bands, preceded vocal communication.

Recent work investigating aphasics' capacity for imitating gestures and manual signs (Daniloff, Fritelli, Buckingham, Hoffman, & Daniloff, 1986) has supported Kimura's view. It was concluded that if the output systems of speech and gesture are overlaid upon the same "general cognitive/movement cerebral systems" then "we might expect that gesturing would help stimulate a verbal, articulatory system" (p. 111).

Further research on the gestural facilitation of verbal expression is needed for theoretical purposes, but perhaps more importantly, for the determination of its practical therapeutic applications in severe aphasia. The present study was completed in order to replicate the preliminary findings of the pilot study and to determine if there is a differential effect among diagnostic subtypes, particularly anterior versus posterior aphasics. The potential for application of this technique (pointing gestures) in aphasia rehabilitation would appear to be rather high, due primarily to the efficiency with which it can be utilized and the increased adaptive functioning it may provide.

Chapter II

Gesture and Naming in Aphasia

The associations among aphasia, apraxia, and gestural communication represent a topic of debate and considerable controversy in the field of neuropsychology, and particularly aphasiology. The two primary theoretical camps with respect to this issue fundamentally differ in terms of the role which linguistic processing is assumed to play. Following Finkelnburg's (1870) original conceptualization of "asymbolia" as a central communication disorder denoting a deficient capacity in both the expression and comprehension of symbols, regardless of the modality through which they are conveyed, the idea that gestural deficits reflected a representational loss prevailed. Head (1926), Jackson (1932), Critchley (1939), and Brain (1961) all supported the position that gestural disturbance is inextricably related to aphasia, both of which are manifestations of a generalized symbolic disturbance.

In 1900, Liepmann, following de Buck (1899) defined apraxia as a dissociation between the concept of an action and its motoric execution, although comprehension of the movement command and sensory-motor integrity remain intact. He subsequently (1905) elaborated his position on the nature of gestural disturbance in which he insisted that difficulty in the execution of such expressive

movements is a manifestation of apraxia, rather than aphasia. While concluding that the left hemisphere controls all skilled and purposive movements and that apraxia is invariably associated with left hemisphere damage, he noted that all aphasic individuals are not apraxic, and of those who do manifest apraxia, there is no consistent relationship based on severity. Furthermore, Liepmann (1908) observed that not only were apraxic individuals impaired on motoric responses to command, but they were typically unable to accurately imitate movements demonstrated by the examiner. For Liepmann, this final point provided solid evidence that gestural disturbance was due to defective motor control and organization, rather than a general representational or symbolic deficit. This theoretical dispute has continued to the present as a result of an extensive number of studies in which evidence has been offered in support of both sides of the issue.

Gestural Disturbance in Aphasia

Goodglass and Kaplan's (1963) seminal investigation of the gestural disturbance in aphasia attempted to clarify the "issue of apraxia vs. a central communication disorder" (p. 704) by means of a controlled group study of the gestural ability of aphasics and non-aphasic brain-injured controls, matched for age and intellectual capacity. They hypothesized that if the gestural disorder

is an exclusive manifestation of apraxia, then both imitative and spontaneous gestural actions should be defective, in addition to gestural responses to commands. Also, in line with Liepmann's (1905) localization of purposive movement in the area of the supramarginal gyrus, they reasoned that due to intrahemispheric proximity the "deficiency should be frequently encountered in association with aphasia but, should also be found, on occasion, in the absence of aphasia" (p. 704). Their findings lent strong support to Liepmann's view that the gestural disturbance should be categorized as ideomotor apraxia, refuting the concept of a central communication disorder.

While demonstrating that aphasics were more impaired on both gestures and pantomimes than non-aphasic brain injured controls, there was no direct correlation between severity of aphasia and level of gestural disorder. Furthermore, the aphasics as a group did not significantly improve their gestural performance on attempts at imitation, suggesting that the gestural disturbance marks a deficiency in executing purposeful movements - an apraxic disorder. Interestingly, gestural performance was directly related to intellectual capacity, regardless of the presence of aphasia.

As a sideline of particular relevance to the present study, one intriguing point that Goodglass and Kaplan

(1963) noted, and included as a qualitative scoring category, was the occurrence of what they termed "vocal overflow" (p. 713). This involved the spontaneous emission, among the aphasics, of the word which was being gesturally represented at a given moment. While the occurrence of vocal overflow was not related to the severity of aphasia, the incidence among aphasics was four times that of the controls. In relation to the present study it should be noted that the aphasics in the Goodglass and Kaplan study were predominantly of the nonfluent expressive type.

In line with the conclusions drawn by Goodglass and Kaplan (1963), following Liepmann (1920), Kimura (1974, 1976, 1979, 1982) is also a proponent of the view that the gestural communication deficit of aphasics is an apraxic disorder, defending her position from an evolutionary perspective. On the view that the left hemisphere is primarily responsible for the production and control of complex motor sequences, both oral and brachial, rather than symbolic-language processes (Kimura and Archibald, 1974), she has presented compelling evidence in support of the hypothesis that aphasic gestural disturbance is an apraxic disorder.

In support of Liepmann's (1905) contention that apraxia should be considered as a disorder of movement, rather than a representational disorder, as suggested by Finkleinburg (1870), Kimura and Archibald (1974)

demonstrated that left hemisphere lesioned patients were significantly impaired on the imitation of meaningless or nonrepresentational movements, relative to right hemisphere damaged patients. This differential deficit was demonstrated in addition to the commonly observed defect in the performance of motor acts to verbal command. Moreover, the impaired imitation was restricted to the production of sequential movements, not static hand postures, which has led Kimura to suggest that the left hemisphere is specialized for the control and performance of complex motor sequences.

While both Liepmann (1908) and von Monakow (1914) had established the common association between lesions of the left supramarginal and left angular gyri, and bilateral apraxia, Kimura has expanded on Liepmann's (1908) original hypothesis regarding the left hemisphere control over "purposive" movements. She has presented extensive evidence on the view that neuropsychological specialization of the left hemisphere may be conceptualized in terms of the production and organization of motor sequences which lend themselves to communication (Kimura, 1976).

In addition to the relationship between the copying of movements and the production of movements to command (Kimura & Archibald, 1974), she supports this hypothesis with the results of work involving the relation between hand preference and manual skill (Kimura & Vanderwolf,

1970) and the manual activity which occurs during speaking (Kimura, 1973). With respect to the latter study she concluded that "activation of the speech system in the left hemisphere is associated with concomitant activation of certain other motor systems in that hemisphere" (Kimura, 1976, p. 148). Disorders of manual signing or manual sign language aphasia in deaf individuals following left hemisphere lesions has also been cited in support of the motor control disorder hypothesis (Kimura, 1979).

In an elaborate investigation of this theoretical model, Kimura (1982) differentiated the effects of left frontal lesions and left parietal lesions on motor control functions, including both oral and brachial movements. Although both left anterior lesioned and left parietal lesioned groups were impaired, relative to comparable right hemisphere lesioned patients, on the imitation of sequential manual movements and sequential oral movements, a dissociation was determined for single movements. The left frontal group was also impaired on the imitation of single oral movements, whereas the left parietal group, in addition to defective performance on both oral and manual sequences, was also impaired on the imitation of single hand postures. This pattern suggests a considerable degree of overlap between the oral and manual control systems (Kimura, 1982). Conversely, patients with temporal lobe lesions were not impaired on oral or manual movements, but were the only group significantly impaired

on the reproduction of multisyllabic phrases. Considering the close association between aphasia and the motor control deficits of these patients, particularly the oral and brachial/manual sequential movements, she has concluded that "apraxia, as well as aphasia, may be a manifestation of a basic motor selection problem in lesions of frontal and parietal lobes" (Kimura, 1982, p. 135).

On the flip side Duffy and his colleagues (Duffy, Duffy and Pearson, 1975; Duffy and Duffy, 1981) among others (Pickett, 1974; Kadish, 1978) adhere to the view that aphasia is a general symbolic communication disorder which subsumes non-verbal and gestural deficits. Evidence for this position has arisen from reports that gestural ability is strongly related to the severity of aphasia and that aphasics demonstrate improvement on imitative tasks. However, Helm-Estabrooks (1984) has pointed out that such findings should be considered with caution due to the type of gestural tasks employed and the instruments used to assess aphasia. Duffy and Duffy (1981), Duffy, et al. (1975), and Pickett (1974) predominantly focused on the recognition and expression of representational gestures (pantomimes of pictured objects) and all used the Porch Index of Communicative Ability (PICA) as the measure of severity of aphasia.

Due to the inclusion of gestural subtests in the PICA, Feyereisen and Seron (1982) have noted that the PICA

is an inappropriate instrument for the determination of severity of aphasia when considering the role of nonverbal and gestural capacity. Kadish (1978) used the Boston Diagnostic Aphasia Examination (BDAE) to assess the aphasic language deficit and was only able to demonstrate a significant relationship between auditory-verbal comprehension and receptive gesture (pantomime recognition). Additionally, the exclusion of meaningful intransitive gestures in these studies as well as the predominant inclusion of nonfluent aphasics (Duffy and Duffy, 1981) detracts from the support for a central symbolic deficit hypothesis.

In another study, Gainotti and Lemmo (1976) found a strong correlation between aphasics' auditory-verbal comprehension and symbolic gestural comprehension, as measured by pantomime recognition of pictured objects. However, as Christopoulou and Bonvillian (1985) have pointed out the criterion which Gainotti and Lemmo (1976) established for intact gestural comprehension (100%) should be reconsidered in light of the fact that about 20% of the aphasic subjects achieved the 90% accuracy level, in addition to the approximately 40% who achieved 100% accuracy for gestural comprehension. Although Gainotti and Lemmo did not interpret these findings as evidence for a central symbolic communication deficit, but rather as defective verbal coding of the demonstrated pantomime, it is clear that a minor alteration in the cut-off markedly

alters the end result. Moreover, the heterogeneity of the aphasic population between and within aphasic subtypes for both verbal and gestural capacity, and the inconsistency between the two, as well as the inconsistency observed between gestural comprehension and expression, make it difficult to defend the central symbolic communication theory.

Gestural Comprehension

At this point delineation of the specific aspects of both gestural comprehension and expression appears to be in order. The qualitative aspects of gestural comprehension will be addressed first. A number of studies have revealed that aphasics are deficient in pantomime interpretation, relative to normal controls (Seron, van der Kaa, Remitz, & van der Linden, 1979), to right hemisphere lesioned controls (Duffy and Duffy, 1981), to subcortical lesioned controls (Duffy, et al., 1975), and both nonaphasic left hemisphere lesioned and right hemisphere lesioned controls (Gainotti and Lemmo, 1976).

On a drawn pantomime recognition test aphasics were deficient on pantomime interpretation, but there was no relationship between the non-verbal deficit and severity of aphasia or between pantomime interpretation and different aphasia subtypes (Seron, et al., 1979). However, a qualitative analysis revealed that while there

was no significant difference between semantic and morphological errors, the degree of plausibility of a distractor in relation to the movement depicted in the drawing of a given pantomime directly influenced interpretation errors.

Using the Amer-Ind signing system (Skelly, 1979; Skelly, Schinsky, Smith, & Fust, 1974) Danilooff, Noll, Fristoe, and Lloyd (1982) developed the Amer-Ind Recognition Test. In a study of 15 aphasic patients of unspecified subtypes they found no relationship between gesture recognition and severity of aphasia, in that all of the aphasic subjects from each of the three severity classifications, as established on the Aphasia Language Performance Scales (Keenan & Brassell, 1975) performed equally well. Perhaps more interesting, however, was the finding that recognition of gestures representing actions was considerably better than recognition of gestures representing objects, for all three levels of severity (Danilooff, et al., 1982). Similarly, Netsu and Marquardt (1984) investigated the effect of stimulus characteristics on pantomime interpretation using stimuli consisting of objects, static pictures (line drawings of the objects), and action pictures depicting the objects in contextual use. They found that aphasic subjects were significantly better in interpreting both action pictures and objects in comparison to static pictures, while there was no

significant difference in performance between action pictures and objects.

In a study directed toward the determination of the existence of a relationship between pantomime recognition and linguistic functioning Varney (1978) discovered a strong correlation (.87) between pantomime recognition and reading comprehension. Using the visual naming, aural comprehension, and reading comprehension subtests of the Multilingual Aphasia Examination (Benton, 1969) and a 30-item pantomime recognition test, Varney (1978) determined that in contrast to both visual naming and aural comprehension, reading comprehension was closely related to pantomime recognition. Additionally, he concluded that "impaired pantomime recognition was always associated with reading comprehension defects of at least comparable severity" (Varney, 1978, p. 567).

In their review of various aspects of nonverbal communication of aphasics, Feyereisen and Seron (1982) cite extensive evidence of aphasics' residual comprehension of nonverbal signals. In a previous study, Feyereisen, Seron, and de Macar (1981) compared pantomime interpretation to the interpretation of "natural" movements consisting of emotional and physiological reactions, and to conventional symbolic gestures. While both aphasics and right hemisphere damaged subjects were uniformly deficient relative to normal controls, aphasics typically performed better on pantomime interpretation

than on interpretation of the "natural" signs. In a study on the recovery of function, Ferro, Mariano, Castro-Caldas, and Santos (1980) reported that improvement in pantomime interpretation was related to recovery of auditory comprehension, but that nonverbal improvement exceeded verbal recovery.

In more recent work on the imitation and recognition of sets of semantically matched Amerind gestures and ASL (American Sign Language) signs (Daniloff, Fritelli, Buckingham, Hoffman, & Daniloff, 1986), it was found that for aphasics, as well as nonaphasic right hemisphere lesioned subjects and normals, the Amerind gestures were considerably easier to imitate and recognize than comparable ASL signs. Daniloff and Vergara (1983) had previously determined that Amerind gestures are motorically easier to produce than ASL signs, due to the comparatively extensive fine motor involvement of the latter, deeming them more motorically intricate and demanding. Daniloff, et al. (1986) concluded that the fine motor coordination required to produce the movement patterns of ASL signs, unlike Amerind, is similar to the precise coordination necessary for vocal articulation. On this view she concurs with Kimura (1977, 1982) by proposing that "language is a complex system that is overlaid, or scaffolded upon a more general - and evolutionarily older - cognitive/movement system" (Daniloff, et al., 1986, p. 97).

Finally, Ferro, Martins, Mariano, and Castro-Caldas (1983) have correlated gesture recognition disturbance with lesion site (located by CT scan) in aphasics. The relationship between the impaired recognition of gestures and location of lesion varied according to the stage of recovery, or more specifically, time since onset. Patients still in the acute stage (less than one month post-onset) with disturbed gesture recognition ability tended to have lesions involving the frontal lobe and/or basal ganglia, whereas the lesions of patients in the later stages generally involved the parietal lobe, particularly the angular gyrus (Ferro, et al., 1983).

Gestural Expression

Considering the expressive side of gestural communication, Wiener, Devoe, Rubinow and Geller (1972) provided an extensive analysis of the properties of nonverbal communication. After reviewing the major theoretical views on nonverbal communication with particular emphasis on the factors required to constitute a communication system, Wiener, et al. (1972) noted that such a system, like the verbal system, must function to make experience public by employing a shared code or set of components having a finite number of designated referents, which may be encoded and decoded. They operationalized nonverbal encoding by means of the following process. An identifiable set of behaviors which is associated with the

consensually accepted code of verbal language behavior is determined. Next, it must be established that "predictable nonverbal behaviors will be introduced when the verbal possibilities are constrained" (p. 206), and that these nonverbal behaviors may be conventionally decoded.

They concluded that if the aforementioned criteria of predictability and consistency of decoding are achieved a nonverbal code which may substitute for the verbal code is established. In employing the concept of "channel" which Wiener and Mehrabian (1968) defined as a systematically observed set of behaviors, considered to be coded for communication, Wiener, et al. (1972) outlined a set of communicative gestures involving arm and hand movements. Two major categories were delineated, namely pantomimic gestures and semantic modifying and relational gestures.

Of the pantomimic gestures, formal gestures may be differentiated from improvisational gestures based on the degree of consensual meaning, as culturally prescribed. While both types function as the nonverbal counterpart of nouns in that they depict objects or events, the former are invariant in meaning (e.g., waving goodbye, giving "the finger"), but the latter are situationally dependent and vary according to the context in which they are used (i.e., denoting physical attributes).

Semantic modifying and relational gestures may be subdivided into three classes: deictic or pointing

movements which serve to specify or locate in space; the orientation of palms which signifies relationship to the addressee; and semantic forms, including circling and oscillation gestures, arrhythmic and rhythmic chopping gestures, and expansion-contraction gestures. In contrast to the formal pantomimic gestures, semantic modifying and relational gestures generally accompany and accentuate verbal communication, functioning as the nonverbal counterparts of adjectives and adverbs (Wiener, et al., 1972).

More recently Glosser, Wiener, and Kaplan (1986), using the criteria for communicative gestures outlined by Wiener, et al. (1972), studied the gestural productions of aphasics in two separate conditions: face-to-face dyadic conversation and restricted visual access interaction. Concentrating on both the extent and quality of deictic or pointing movements, other semantic modifying and relational gestures, and pantomimes, Glosser, et al. (1986) employed the method of elimination of visual access (Mahl, 1961; Cohen, 1977) in attempt to determine the communicative function of these gestural behaviors. That these gestural behaviors serve a communicative function was demonstrated by a significant reduction (50%) in gestural emission during the visually restricted condition, in comparison to the face-to-face condition for both mild and moderately impaired aphasics, as well as normal controls. Furthermore, there was no significant

difference in frequency of total gestures produced during the normal face-to-face situation between aphasics and normals, although the moderately impaired aphasics tended to produce less complex gestures.

In a detailed study of the differential aspects of gestural behavior in a small sample of aphasics (two Broca's and two Wernicke's), Clcone, Wapner, Foldi, Zurif, and Gardner (1979) found that gestural productions essentially parallel the speech properties which characterize these aphasic subtypes. Analyses of the physical parameters, temporal occasions, and both semantic and pragmatic aspects of gestural emissions during an informal interview revealed that the anterior or Broca's aphasics gestured infrequently, producing simple, unitary gestures which were generally considered to be informative and intelligible. The Wernicke's aphasics gestured frequently and extensively relative to the anterior patients and their gestures were comparatively complex and elaborate, although typically less clear and less informative than the Broca's aphasics (Clcone, et al., 1979).

In line with this gesture-speech pattern consistency, the two aphasic subtypes also differed with regard to the type of gestures emitted. Having differentiated referential from nonreferential gestures based on whether a gestural unit makes reference to an object, action, or idea, Clcone, et al. (1979) discovered that the Broca's

aphasics produced a much higher proportion of referential gestures (82%) than the Wernicke's aphasics (59%) or normal controls (48%). Interestingly, of the referential gestures produced by the aphasic subjects, the anterior patients predominantly emitted iconic gestures which involved some specification of the attributes of the referent, whereas the posterior patients emitted more noniconic or pointing gestures. The relatively advanced informative nature of the anterior patients' gestures is understandable in light of these qualitative differences.

Cicone et al. (1979) suggest that these findings, particularly the relation between speech and communicative gestural behavior, may be interpreted on the view which holds that some form of central apparatus controls both speech and gestural expression (Kimura & Archibald, 1974). This view is founded on the theory that gestural communication and speech share a phylogenetic origin (Hewes, 1973; Bates, 1976).

In contrast to the findings of the Cicone, et al. (1979) study, Goldblum (1978) reported that during open conversation anterior aphasics produced more gestural activity as measured on a gesture-to-words ratio, than right-lesioned, left-lesioned nonaphasic, and normal subjects. Additionally, Feyereisen (1982) concluded that verbal fluency was not a determining factor in the differential gestural production of Broca's aphasics, Wernicke's aphasics, and normals. He noted "that for

different gestural indices (duration of movements, gesture rate, gesture-to words ratio) the nonverbal production was greater for the aphasics than for the normals" (Feyereisen & Seron, 1982, p. 220).

In addition to their review of the findings on non-verbal comprehension, Feyereisen and Seron (1982) have contributed an extensive review of nonverbal expressive communication in aphasia. After delineating the major theoretical positions on disturbances of communicative gestural production or ideomotor apraxia (i.e., central or generalized communication disorder vs. defective left hemisphere organizational system controlling complex motor sequences) which was previously addressed in this discussion, they outlined the research which has examined the manual activity of aphasics, co-occurring with speech.

Several functionally oriented hypotheses on the nature of gestural behavior in aphasics were also outlined by Feyereisen and Seron (1982). The substitution hypothesis holds the practical view that gestures replace verbal expression and convey the information ordinarily represented by words. The connotative meaning hypothesis of Mehrabian (1972) holds that the nonverbal channel of communication, unlike the verbal channel, is specialized for the implicit information of emotional communication, while Kendon's (1972) semantic planning hypothesis considers concurrent movements as the structural framework of verbal expression.

The role of gestural activity in the development of communicative ability has been addressed by several developmental theorists. In addition to the changes in gestural behavior which accompany the development of verbal expression (Keller-Cohen, 1978; Jancovic, Devoe, & Wiener, 1975; Evans & Rubin, 1979), Bruner (1975, 1977) and Bates, Camaioni, and Volterra (1975) have noted that gestural components constitute the precursors of units of speech in infants. McNeill (1975) has expanded on this view, suggesting that the sensory-motor level of communication which characterizes gestural productions marks the original representation of meaning contents as action schemas, which subsequently develop toward more abstract levels of communication via speech.

Therapeutic Applications

The application of these findings on the aspects of gestural and other nonverbal communication to the therapeutic domain has generated a number of group and single case studies, which have generally supported the utility and efficacy of such interventions with aphasics. A few studies have specifically addressed the capacity of severely aphasic patients to acquire and utilize nonverbal communication systems comprised of nongestural symbols presented visually. Glass, Gazzaniga, and Premack's (1973) original experimental work on the capacity of global aphasics to learn an artificial language system, in

which paper symbols represented words, demonstrated that even global aphasics retain some capacity for communication via symbolic elements. By employing an artificial language system based on a system which Premack (1971) had previously developed for work with chimpanzees, Glass, et al. (1973) determined that despite severe language impairment, global aphasics were capable of varying degrees of symbolization for communicative purposes.

Gardner, Zurif, Berry, and Baker (1976) carried this line of research a step further through the development of a "visual communication system" (p. 275) which was employed in a structured therapy program with severe (predominantly global) aphasics in an attempt to provide an alternative system for functional communication. Patterning elements of the symbol system in accordance with the properties of natural language, Gardner, et al. (1976) concluded that "severely aphasic patients can use a system of visual symbols to act upon command, answer questions, and describe actions in their immediate situational environment" (p.288). Furthermore, a small proportion of the aphasics trained on the visual communication system ultimately acquired the relatively advanced ability of spontaneously expressing their feelings and desires via the symbol system. Interestingly, the partial retention of conventional language functioning, albeit ineffective, interfered with

and appeared to inhibit the acquisition and effective use of the alternative system (Gardner, et al., 1976).

More recently, Johannsen-Horbach, Cegla, Mager, Schempp, and Wallesch (1985) have reported some success in the treatment of global aphasics with Blissymbols, a system of visual-graphic symbols composed of ideograms and pictograms (Bliss, 1965). While single case studies (Kirby, 1978; Bailey, 1978) and a small group study (Lane & Samples, 1981) had previously reported limited success in advancing communicative capacity via Blissymbolics, Johannsen-Horbach, et al. (1985) noted that of the four global aphasics they trained, three were capable of producing Blissyntactically intact sentences in response to Blissymbolic questions. Unlike the visual communication system of Gardner, et al. (1976) in which symbolic elements were presented nonverbally and nongesturally, in the Johannsen-Horbach, et al. (1985) study Blissymbols were introduced verbally with their referents and/or by pantomime.

An intriguing aspect of this Blissymbol training program and one not unlike the "vocal overflow" noted by Goodglass and Kaplan (1963) during gestural productions, was the "simultaneous articulation" (p. 79) of correct words while pointing to their corresponding visual symbols. In fact, only one of the four global aphasics in the Johannsen-Horbach, et al. (1985) study failed to demonstrate this phenomena to some extent during training.

Attempts to facilitate communicative ability and particularly the expression of severely aphasic patients via the gestural modality have generally proven encouraging. Chester and Egolf (1973) have stressed the need to incorporate nonverbal, gesturally oriented interventions in aphasia therapy programs, since a vast amount of communication is mediated nonverbally. Chen (1971) has reported modest success with a combined manual alphabet/gesture (predominantly pointing) system which he termed "manual shorthand" (p. 381) communication. Skelly has advocated the therapeutic use of American Indian Sign (Amerind) (Skelly, Schinsky, Donaldson, & Smith, 1973) with aphasics (Skelly, Schinsky, Donaldson, & Griffin, 1975; Skelly, 1979), and in patients with severe oral apraxia (Skelly, Schinsky, Smith, & Fust, 1974). In addition to the advanced communicative ability provided by acquisition of this signal system, she has consistently reported the concurrent facilitation of verbalization during gestural expression with Amerind (Skelly, et al., 1974; Skelly, 1979).

Others have also employed Amerind in single case (Hellman, Rothi, Campanella, & Wolfson, 1979) and group (Rao, 1979) treatment studies with encouraging results. In a couple of single case reports, training on the use of American Sign Language (ASL) signs exclusively (Bonvillian & Friedman, 1978) and in combination with Amerind training (Kirshner & Webb, 1981) resulted in mastery of up to 100

signs, significantly facilitating functional communication.

Schlanger and her colleagues have conducted an extensive series of studies on the pantomimic expression and comprehension of aphasics. Aside from the development of the Schlanger-Koller Index of Pantomimic Reception (SKIPR) (Koller & Schlanger, 1974), an instrument designed for the assessment of pantomimic comprehension, Schlanger (Tenenbaum & Schlanger, 1968; Schlanger & Schlanger, 1970; Schlanger, DiCarrado, & Geffner, 1974) has repeatedly noted the relatively well preserved inherent capacity of aphasics to express themselves via gesture and pantomime.

In two studies of pantomime therapy with severely aphasic patients (Schlanger, et al., 1974; Schlanger & Freimann, 1979) involving totals of 2.5 and 8 hours of training, respectively, it was concluded that not only could aphasics learn a specific repertoire of pantomimes on which they had been trained, but they could also generalize their gestural expressions to new situations. Again with particular relevance to the present study, it was noted that in both of these pantomime therapy studies "aphasics could learn to use pantomime as a substitute for or adjunct to verbal speech, and that pantomime, moreover, facilitated spontaneous verbalization" (Schlanger & Freimann, 1979, (p. 35). It was suggested that the universality of pantomimes combined with the direct relationship between a given sign and the idea it

represents enables aphasics to readily communicate through this modality (Schlanger & Freimann, 1979).

Building on the Gardner, et al. (1976) work with the nonverbal visual communication system, discussed above, Helm-Estabrooks (Helm-Estabrooks, Fitzpatrick, & Barresi, 1982; Helm & Benson, 1978) has developed a gestural communication system referred to as "visual action therapy" (p. 385) specifically for global aphasics, in attempt to facilitate gestural expression. The visual action therapy program entails training on the pantomimed gesture of eight manipulable objects. Like the visual communication system of Gardner, et al. (1976) all directions and demonstrations of visual action therapy are nonvocal. With a pre-post test design using scores on PICA subtests, Helm-Estabrooks, et al. (1982) found a strong generalization effect from the training program on the gestural-pantomime subtests scores, as well as improvement on the auditory comprehension scores. Considering the incidence of left limb apraxia in global aphasics with right hemiplegia they noted that training on the production of representational gestures should actually be considered praxis therapy. Nevertheless, the acquisition of a limited set of gestural productions combined with potential for generalization facilitates the overall communicative ability of global aphasics.

In addition to the group study by Rao (1979) on the use of Amerind sign with aphasics, a previous single case

study by Rao and Horner (1978) on the facilitation of gestural behavior with a severe aphasic is of particular interest because of the theoretical model on which they based their clinical findings. This patient was observed to gesture spontaneously in apparent attempt to mediate both comprehension and speech. Based on the transcoding model (Weigl & Fradis, 1977) gesture, for this patient, served as a channel for functionally connecting the disrupted linguistic modalities of reception and expression, and provided a "means of access to conventional language processes" (Rao & Horner, 1978, p.181). On this view the transcoding modality of gesture "deblocked" the dysfunctional linguistic input and output modalities, and facilitated "vocal elaboration" (p. 183), as well as receptive-expressive language functions.

Considering the preserved communicative competence of aphasics described by Holland (1977), Davis and Wilcox (1981) encourage the employment of gestures as a supplemental channel of expression in the treatment of aphasia. Their PACE (Promoting Aphasics' Communicative Effectiveness) therapy program advocates the utilization of gestural behaviors, to facilitate communicative ability.

Since the present study is primarily concerned with the effect of different types of gestural activity on naming ability, this discussion will proceed with a review of the findings on the naming disorder in aphasia. Such

findings include the various factors which have been implicated in affecting the naming capacity of aphasics and approaches directed toward the facilitation of the naming process.

Naming Disorder in Aphasia

An extensive body of literature exists on the nature of anomia or word finding difficulty in aphasia. Particular emphasis has been placed on the various forms of disordered naming and paraphasias, the differentiation among aphasia subtypes with respect to naming difficulty, and the stimulus variables and cues which affect naming performance. Goodglass and Kaplan (1972) have noted that "virtually all aphasics suffer some restriction in the repertory of words that they have available for speech" (p. 6), while Goodglass and Geschwind (1976) have suggested that some degree of reduction of available lexical items is a general and essentially invariable symptom of all aphasia subtypes. As such, defective naming ability represents a ubiquitous, functionally limiting symptom which characterizes all types of aphasia.

The issue of word finding has been addressed theoretically from the perspective of each of the disciplines involved in aphasia research (Geschwind, 1967; Luria, 1970; Brown, 1977; Goodglass & Blumstein, 1973; Whitaker & Whitaker, 1977; Caramazza & Berndt, 1978). A comprehensive analysis of each of these various

perspectives is beyond the scope of this discussion, however the neuropsychological models of Luria (1970) and especially Brown (1977) hold particular relevance to the present study.

In accordance with Luria's classification of the aphasias, he distinguished between the functional basis of the nominative difficulties which characterize motor and sensory or temporal aphasia. In Luria's (1970) view, the naming difficulty manifested in motor aphasia is due to "difficulty in recalling the articulatory images of words" (p. 294), which results in the phonemic and syllabic distortions of phonemic or literal paraphasias. The "acoustico-gnostic" disturbance of the sensory aphasic, on the other hand, produces an "instability and diffuseness of the auditory images of words" (p. 295), resulting in both phonemic and semantic paraphasias.

In Brown's (1977) view, the pathological manifestations of the various aphasias represent different levels within the hierarchy of language formation. On this microgenetic model the process of naming, of producing a lexical item, ascends through semantic, nominal, and phonemic levels. Speech or the utterance of the word, arises through a three-stage action microgeny simultaneously, ultimately resulting in articulation. Expressive defects, such as impaired naming, represent "interruptions at successive stages in a process which leads from word-finding to articulation" (Brown, 1972, p.

14). On this view, the various naming defects reflect the preliminary levels at which the formative process is derailed.

Influential Factors in Naming

The defective naming capacity of aphasics has intrigued aphasiologists for as long as aphasia has been recognized as a diagnostic syndrome. An extensive number of studies have been directed toward the investigation of the factors which contribute to this disturbance and specifically influence the naming process. The variables which have been implicated in limiting the naming capacity of aphasics include the fundamental linguistic properties of the word tokens, such as frequency, semantic category, and the context in which words are generated. Other variables include the sensory modality through which naming stimuli are presented, the inherent sensorimotor characteristics of stimuli, types of naming errors relative to aphasic subtypes, and other behavioral manifestations characteristic of defective naming performance.

That the frequency of word usage or the frequency with which a given word appears in the language constitutes an integral factor in the naming capacity of aphasics has been conclusively demonstrated in terms of response availability (Wepman, Bock, Jones, & Van Pelt, 1956; Newcombe, Oldfield, & Wingfield, 1965; Newcombe,

Oldfield, Ratcliff, & Wingfield, 1971; Howard, Patterson, Franklin, Morton, & Orchard-Lisle, 1984) and response latency (Newcombe, et al., 1965; Newcombe, et al., 1971). An inverse relationship between frequency and response latency has similarly been demonstrated with normals (Oldfield & Wingfield, 1965; Goodglass, Theurkauf, & Wingfield, 1984). Goodglass, Hyde, and Blumstein (1969) elaborated on the word frequency issue as interpreted by Wepman, et al. (1956), in terms of the picturability of the nouns emitted by Broca's and fluent aphasics in structured speech samples. They concluded that these two types of aphasia may be differentiated along the lines of picturability or the extent to which visual imagery is presumably elicited by the words emitted in conversation. In examining the interaction between frequency and picturability there was no significant difference between the diagnostic groups with respect to picturable nouns. However, the fluent aphasics, unlike the Broca's patients were characterized by an extreme overrepresentation of nonpicturable, high frequency nouns.

Word length has also been implicated in word finding difficulty, with increasing syllable length resulting in an increased rate of naming failure (Goodglass, Kaplan, Weintraub, & Ackerman, 1976; Howard, Patterson, Franklin, Morton, & Orchard-Lisle, 1984). Goodglass, Klein, Carey, and Jones (1966) analyzed the relative naming difficulty and differential word finding capacity for items

representing several semantic categories (objects, colors, numbers, letters, and actions). Although objects were the most difficult category and letters the easiest category for naming, a comparative analysis according to diagnostic classification (nonfluent vs. fluent) revealed that this semantic difference in naming performance characterized only the fluent aphasics. The "Broca's aphasics, in contrast, showed no significant differences between the various semantic classes in their naming proficiency" (Goodglass, et al., 1966, p. 88). In a more recent study on naming performance across sixteen semantic categories, Goodglass, Wingfield, Hyde, and Theurkauf (1986) reported that 25% of their aphasic subjects performed considerably better on specific semantic categories in relation to their overall naming ability. Deviantly high scores predominantly occurred with the categories of letters, body parts, and colors. Interestingly, dissociations between naming and comprehension, favoring naming, commonly involved the same three semantic categories, particularly for the fluent aphasics (Goodglass, et al., 1986).

Variation in the context of the stimulus presentation for naming, whether it be linguistic, sensory, perceptual, or conceptual has proven to influence naming to varying degrees. Comparing aphasic naming performance on the three stimulus contexts of picture naming, sentence completion, and naming to description Barton, Maruszewski,

and Urrea (1969) found that naming to complete open-ended sentences was easiest. Picture naming was slightly more difficult, while naming to description was the most difficult of the three tasks. Although there was naturally variation across subjects, for each of the diagnostic groups included (Broca's, Wernicke's, conduction, and anomic) this difficulty sequence represented the typical performance pattern.

The findings of Barton, et al. (1969) were partially replicated by Goodglass and Stuss (1979) in a study which compared the naming performance of Broca's, Wernicke's, and anomic aphasics on the two stimulus contexts of visual confrontation and oral description. For both the Broca's and the Wernicke's groups visual confrontation naming was significantly better than naming in response to oral description. The performance of the anomics, however, was essentially unaffected by stimulus context. Furthermore, while the Broca's subjects were advanced relative to both of the posterior groups on the picture naming condition, they were significantly superior to the Wernicke's aphasics on oral description. Incidentally, covariance on the auditory comprehension factor revealed that this characteristic deficit of the Wernicke's subjects did not contribute to their comparatively reduced performance. Differentiation of aphasic subgroups as a function of response to cuing was also demonstrated (Goodglass & Stuss, 1979), but that finding will be discussed

subsequently, in the section on the facilitation of naming via cuing.

In other work on the influence of situational context, Williams and Canter (1982) compared the performance of aphasic subgroups on visual confrontation naming of individually pictured objects and description of composite pictures consisting of four items each. They found that situational context "differentially influenced" (p. 100) the naming performance of the Broca's and Wernicke's subjects. The Broca's aphasics were significantly better in naming individual items to visual confrontation than they were on naming within the context of picture descriptions. Conversely, the Wernicke's subjects performed significantly better within the descriptive context than they did on single item confrontation (Williams & Canter, 1982).

Since naming to visual confrontation constitutes the standard procedure for assessment of naming ability of aphasics and other pathological groups with naming disturbances (Geschwind, 1967), the physical characteristics of the visual stimuli have been a point of concern. In response to conflicting evidence from previous studies regarding the variable effect of the physical characteristics of visual stimuli, including objects vs. photographs (Stoler, 1960) and objects vs. reduced-size line drawings (Benton, Smith, & Lang, 1972), Corlew and Nation (1975) extended the examination of the

differential effect of objects vs. reduced-size line drawings on naming performance. On a diagnostically unspecified group of aphasics they reportedly found no difference in naming performance resulting from stimulus variation in "size, color, and dimensionality" (p. 186).

Based on the models of the lexicon developed by Labov (1973) and Miller and Johnson-Laird (1976), both of which hold that conceptual representations are determined by the integration of perceptual and functional information, Whitehouse, Caramazza, and Zurif (1978) attempted to distinguish, with regard to aphasic naming difficulties, between a breakdown in lexical organization and defective retrieval mechanisms. They systematically varied both the physical properties and the context of prototypical representations of containers (cup, bowl, and glass) in a multiple-choice naming paradigm with small groups of Broca's and anomic aphasics. The Broca's subjects' performance reflected apparently intact lexical organization as inferred from their normal (Labov, 1973) capacity for perceptual/functional integration. However, the anomics "showed evidence of lexical distortion, manifested as an inability to integrate perceptual information (e.g., dimensional and handle features) as well as an inability to integrate perceptual with functional information (e.g., dimensional with context)" (Whitehouse, et al., 1978, p.71).

The differential effect of the sensory modality, through which to-be-named objects are presented, on naming performance has been examined, although not extensively. Spreen, Benton, and Van Allen (1966) reported dissociations between tactile and visual naming accuracy in a small proportion of amnesic aphasics. In a more extensive study of modality-specific naming Goodglass, Barton, and Kaplan (1968) found no significant difference in response latencies among objects presented for tactile, auditory, olfactory, and visual naming, with a group of predominantly fluent aphasics.

The influence of the sensory modalities through which we acquire experiential knowledge of objects was addressed in an intriguing study by Gardner (1973). He investigated the contribution of the Piagetian (1970) concept of operativity, which denotes the manipulability of objects, to the naming performance of anterior and posterior aphasics. It was determined that for both aphasic groups objects which were considered to be relatively operative were substantially easier to name than objects of comparable frequency which were considered to be relatively figurative (i.e., those not readily manipulated). The effect of operativity on naming performance was in fact stronger than the effect of word frequency. Gardner (1973) concluded that the capacity to produce the name of a given object is dependent on the ability to arouse sensory-motor schema which have

developed through interaction with the object. As a result "operative elements, which arouse a large set of acts and associations, are more likely to be named than figurative elements which involve only a limited number of schemes" (p. 219).

Facilitation of the Naming Process

Aside from variations in and analyses of the effects of the stimuli on the naming performance of aphasics, another branch of research in the area of naming ability has focused on the naming process. Contributions within this vein include studies of tacit knowledge, consistency, naming errors, and responsiveness to various forms of cuing. Following Barton (1971), Goodglass, Kaplan, Weintraub, and Ackerman (1976) utilized a procedure developed by Brown and McNeill (1966) to examine the "tip-of-the-tongue" phenomenon in aphasics. On the premise that indication of the number of syllables or the initial letter of a word failed upon confrontation naming reflects tacit knowledge of the word, four aphasic subtypes (Broca's, Wernicke's, conduction, and anomic) were compared with respect to this ability. Only the conduction aphasics demonstrated a significant capacity for retrieving these acoustic properties for words which could not be named.

Consistency of naming performance has been assessed in a couple of studies. Brookshire (1972) evaluated the

conditioning effect of sets of previously established easy and difficult items on subsequent naming performance. While attempts at naming difficult items reduced the subsequent performance on easy items, relatively successful performance on sets of easy items "facilitated subsequent performance on difficult items" (p. 554). However, Howard, et al. (1984) reportedly found no sequential effect with regard to success or failure on consecutive items.

Differentiation among the aphasia subtypes according to predominance of specific types of naming errors has been addressed theoretically (Jakobson, 1964; Luria, 1970; Brown, 1977; Caramazza & Berndt, 1978) and clinically (Geschwind, 1972; Goodglass & Kaplan, 1972; Goodglass & Geschwind, 1976; Benson, 1979). Experimental work in this area has primarily focused on the establishment of diagnostic criteria for the aphasia syndromes based on naming error patterns (Kohn & Goodglass, 1985). These studies have predominantly utilized and have based their findings on naming behavior within the confrontation naming paradigm, rather than narrative speech, which has presumably contributed to some of the discrepancies reported between these findings and hypotheses drawn from theoretical models.

In addition to the finding on the differential effect of stimulus context, discussed above, Barton, et al. (1969) reported that predominance of error type also

distinguished posterior from anterior aphasics. In terms of the relative occurrence of paraphasias, the anterior patients were characterized by literal or phonemic errors, whereas the posterior aphasics were characterized by verbal or semantically based errors. However, in contrast to the dissociation of anterior and posterior aphasics proposed by widely accepted theoretical models (Goodglass, 1981; Benson, 1979; Luria, 1970), Williams and Canter (1982) found that "delayed responses, phonemic attempts, and related words were among the four most commonly produced error types" (p. 100) for each of four diagnostic groups (Broca's, Wernicke's, conduction, and amnesic). More recently, Kohn and Goodglass (1985) noted a remarkable degree of similarity among Broca's, Wernicke's, conduction, and anomic aphasics with regard to both type and extent of naming errors. Semantic paraphasias, phonemic paraphasias, and multiword circumlocutions constituted more than 80% of all naming errors produced, the subtypes being essentially undifferentiated with respect to the occurrence of paraphasic errors.

On the theoretical view that Broca's and Wernicke's aphasics may be distinguished according to the linguistic properties of contiguity and similarity, respectively (Jakobson, 1964), Galotti, Miceli, and Caltagirone (1981) analyzed the semantic paraphasias of groups of Broca's Wernicke's, and amnesic aphasics on confrontation naming.

Again, in contrast to theoretical expectations, all three diagnostic groups were characterized by a predominance of paraphasic errors of the similarity type and a relative lack of substitutions of the contiguity type.

Cuing

Approaches to the facilitation of the naming ability of aphasics have concentrated on various types of cuing, including procedures involving linguistic, visual as well as other sensory modalities, and gestural cues. However, before reviewing the findings on the effects of different cuing techniques it should be noted that aphasic individuals often attempt to overcome or circumvent word finding difficulties spontaneously.

Liederman, Kohn, Wolf, and Goodglass (1983) examined the lexical creativity or the capacity to generate lexical innovations in the naming attempts of Broca's and Wernicke's aphasics. Lexical innovations are comprised of two or more morphemes, one of which is semantically related to the referent. In light of the fact that normal adults, as well as both preschool children and grade school children (Liederman, Kohn, & Wolf, 1986) effectively produce lexical innovations, Liederman, et al. (1983) determined that Broca's, but not Wernicke's aphasics produced lexical innovations which were comparable to those of normals, in terms of communicative effectiveness and semantic accuracy. They concluded that,

particularly for Broca's aphasics, "lexical innovation is an effective and pervasive strategy for circumventing word-finding difficulty" (p. 29).

Verbal self-correction strategies utilized by aphasics have also been investigated (Wepman, 1958; Farmer, 1977; Marshall & Tompkins, 1981). While demonstrating that most aphasic patients, irrespective of subtype or severity, attempt to self-correct expressive errors to a considerable extent, Marshall and Tompkins (1982) confirmed Farmer's (1977) finding that the success of verbal self-correctional behaviors is a function of severity, rather than type of aphasia. The less severe aphasics were characterized by greater success in attempts at self-correction.

Cuing is a relatively effective method of facilitating the naming ability of aphasics. Language therapists commonly utilize various cuing strategies specified according to individual patient responsiveness. Brown (1972) outlined a variety of types of cues in relation to the stage within the naming process presumably reflected by responsiveness to specific cue types. The past ten years have seen increasing interest in cuing techniques beginning with Love and Webb's (1977) ranking of cue "potency" for nonfluent aphasics. Not surprisingly, word imitation was the most effective cue for eliciting the correct word. However, phonemic cuing was demonstrated to be significantly more effective than

both sentence completion and written word cues in facilitating accurate naming.

Pease and Goodglass (1978) assessed the differential effect of six types of cues on the confrontation naming performance among several aphasic diagnostic groups. These six cue categories included (1) phonemic cue, consisting of the initial consonant and vowel, (2) superordinate or semantic category, (3) location typically associated with the object, (4) rhyming word, (5) specification of function of the object, and (6) sentence completion. The diagnostic groups did not differ significantly in terms of their responsivity across cues. However, they demonstrated an inverse relationship between responsivity to cuing and severity of naming disturbance. Of the diagnostic groups assessed, anomics benefitted most from cuing, Broca's were second, while Wernicke's subjects benefitted least from every type of cuing. For each diagnostic group phonemic and sentence completion cues were more effective than all other types of cues, but "first sounds had by far the greatest facilitative effect on naming" (p. 188). These results conflict with Luria's (1970) view on the differential naming disturbance of Wernicke's and Broca's aphasics which holds that Broca's, but not Wernicke's patients may benefit from phonemic cues, due to the difference in the stage of the naming process at which the disruption occurs. Pease and

Goodglass (1978) determined that Wernicke's aphasics were also moderately responsive to phonemic cues.

These findings were partially confirmed by Goodglass and Stuss (1979) in a comparison of the responsiveness to phonemic cuing following visual confrontation and visual cuing following oral description. They found that Broca's aphasics were considerably more responsive than the Wernicke's subjects to both phonemic cues and visual cues. When given both visual and phonemic cues they were rarely unable to produce the correct word and were significantly more responsive than both the anomic and Wernicke's aphasics. The differential effectiveness of phonemic cuing among aphasic subgroups was more recently confirmed by Kohn and Goodglass (1985).

In light of the comparatively preserved capacity of Broca's patients to benefit from cuing, particularly phonemic cues, a number of studies exclusively involving Broca's aphasics have been undertaken to further assess and differentiate the cuing potential of this subtype. In addition to the cue-effectiveness hierarchy developed by Love and Webb (1977), which was based on a sample of Broca's aphasics, Weidner and Jinks (1983) compared the effects of single and combined cuing techniques on the naming performance of nonfluent aphasics. They reported that the single cues of sentence completion, written word presentation, and initial syllable were relatively equivalent, in terms of their facilitatory effect.

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However, they concluded that "combined cues facilitate more correct naming responses in (Broca's) aphasic patients than single cues presented in succession" (p. 119).

In a recent attempt to expand upon the findings of Weidner and Jinks (1983), Huntley, Pindzola, and Weidner (1986) assessed the differential effect of dual cue combinations presented simultaneously to anterior aphasics. Although there was no significant difference among the various dual combinations of phonemic cue, sentence completion, printed word, oral spelling, and a multiple-choice presentation, it was determined that the severely aphasic patients benefitted significantly more than those patients with relatively mild word-finding difficulty.

Finally, the effect of gestural cuing on confrontation naming has been preliminarily addressed (Drummond & Rentschler, 1981) in attempt to distinguish the effectiveness of visual-gestural cues from auditory-verbal cues. In one of the few studies based on Luria's (1963) functional reorganization approach to neuropsychological rehabilitation, they found no significant difference in responsiveness between intersystemic (visual-gestural cue/verbal response) and intrasystemic (auditory-verbal cue/verbal response) facilitatory methods. Like the vast majority of research on cuing, this study utilized the standard procedure for

the assessment of cuing efficacy, with gestural cues: provision of cues by another person. With the exception of Helm's (1979) dissertation on the gestural behavior of aphasics during confrontation naming, the author is unaware of any studies which have examined the differential facilitatory effect of self-generated gestures on naming to confrontation.

Chapter III

Method

Subjects. Twenty-four aphasic patients were selected over a period of approximately one year from the Cognitive Rehabilitation Division, Institute for Research in Behavioral Neuroscience and several day program/support groups for stroke victims throughout the New York metropolitan area. The essential clinical criteria for inclusion in the study were a moderate to severe naming impairment and and left-sided neurological damage, due to a cerebrovascular accident. Of the 24 subjects, 17 were male and 7 were female. All 24 subjects were right handed. The age of these patients ranged from 51 to 83 with a mean age of 64 years. The time since onset ranged from 9 to 149 months. Further information regarding age, level of education, time since onset, and severity scores for each of the diagnostic subgroups is presented in Table 1.

The existence of a naming deficit was determined through the administration of the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983). A cut-off score of 35 was established as criterion for inclusion in the study. Subjects were classified by aphasia subtype on the basis of their score profiles obtained from the Western Aphasia Battery (Kertesz, 1979), an instrument developed for research purposes from the Boston Diagnostic Aphasia

Examination (Goodglass & Kaplan, 1972), and neurological criteria (i.e., hemiplegia, sensory deficits). The Western Aphasia Battery also provides a numerical index of the severity of aphasia, the Aphasia Quotient (AQ). The diagnostic distribution of the patients was as follows: 8 Broca's aphasics, 6 Wernicke's aphasics, 4 global aphasics, 4 transcortical motor aphasics and 2 frontal anomics.

Broca's aphasics (n = 8): Each of the Broca's aphasics manifested hemiparesis or hemiplegia of moderate to severe degree, which markedly restricted functional use of the right hand and arm. These patients were characterized by effortful, nonfluent speech which was agrammatic or grammatically restricted with impaired articulation. Their auditory-verbal comprehension was either mildly impaired or intact, but invariably advanced relative to their fluency.

Wernicke's aphasics (n = 6): The patients classified as Wernicke's aphasics were characterized by fluent, well articulated speech which was paraphasic and/or paragrammatic. Auditory-verbal comprehension was moderately to severely impaired, but varied considerably among these patients. One of the Wernicke's patients, who at the time of testing was 9.5 years post-onset, apparently revealed the effects of partial recovery of comprehension. His auditory comprehension scores overlapped with those of the Broca's aphasics.

Global aphasics (n = 4): These patients manifested severely labored, nonfluent speech, which in two of these cases was characterized by stereotyped utterances. All of the global aphasics had relatively severe spastic hemiplegia which restricted functional use of the right arm. Their auditory-verbal comprehension was also impaired from a moderate to severe degree, comparable to that of the Wernicke's patients.

Transcortical Motor aphasics (n = 4): The patients classified as transcortical motor aphasics were characterized by nonfluent, effortful spontaneous speech in the presence of a remarkably well preserved and relatively intact capacity for repetition. Although varying degrees of articulatory and grammatical difficulties were present during spontaneous speech, these errors were typically absent during repetition. Auditory-verbal comprehension was also essentially intact. Like the Broca's aphasics, the transcortical motor patients were either hemiplegic or hemiparetic.

Anomics (n = 2): The anomic aphasics were classified as such based on the presence of fluent, grammatically intact speech accompanied by intact auditory-verbal comprehension, in light of moderate word finding difficulty which commonly produced circumlocutions. It is important to note that both of these cases were considered to be frontal rather than posterior anomics, based on the presence or history of hemiparesis. One of these cases

revealed a mild right hemiparesis at the time of testing. The other anomic patient revealed no motoric impairment at the time of testing, however a mild hemiparetic condition had reportedly resolved during the 5.5 years since onset.

Materials. The naming stimuli consisted of 138 black and white photographs of common objects selected from the Photo Resource Kit (Modern Education Corp., 1979). All of the stimulus items represented medium to high frequency nouns with standard frequency indexes ranging from 36.6 to 66.0 (Carroll, Davies, & Richman, 1971). See Table 2 for a listing of the words used and their American Heritage Word Frequency Book (1971) frequency indexes. The items were divided into three sets of 46 items, each of which was presented in a fixed random order. The stimulus items consisted of words from eight semantic categories: animals, food, vehicles, clothing, tools, household items, personal use items, and appliances. Stimuli within semantic categories were matched across the sets for frequency and number of items within each category.

Procedure. Patients were informed that the study entailed the investigation of the effect of simultaneous gesturing on naming performance. They were told that they would be shown pictures of objects which they should try to name. They were instructed to produce the following movements immediately upon seeing a picture, while trying to name the pictured object: "point to the pictured objects with your right arm" (Set A); "make a fist with

your right hand" (Set B); "point to the pictured objects with your left arm" (Set C). In addition to these verbal instructions, each of the gestural conditions was demonstrated by the examiner prior to the introduction of each set of stimuli. If the patient failed to respond or responded incorrectly to a given stimulus he or she was informed that the response was wrong and was asked to continue both the naming attempt and the gesture. If the patient had not correctly named a given item after 45 seconds, the item was considered failed and the trial was discontinued. Timing was begun upon presentation of the stimulus. Sets were alternated between direct (ABC) and counterbalanced (CBA) orders for presentation to the subjects.

The stimulus pictures were held by the examiner and presented at approximately eye level to the subject. In Condition 1, which entailed pointing with the right arm, the pictures were positioned at approximately a 60 degree angle to the right of the subject. This positioning required the patient to rotate his or her head and/or trunk to the right in order to see the stimulus. Such rotation typically elicited the asymmetrical tonic neck reflex in the hemiplegic patients enabling them to approximate a pointing gesture with their right arm. In Condition 3, which entailed pointing with the left arm, the stimuli were presented at a comparable angle to the left of the subject. During Condition 2 (making a fist

with the right hand, or if hemiplegic, trying to flex the fingers of the right hand) the stimuli were presented directly in front of the patient. They were instructed to only move their fingers and to avoid moving their right arm. Condition 2 was included in the procedure as a control measure, to rule out the effects of general left hemisphere activation.

Statistical Analysis. As previously stated, the purpose of this study was to test the hypothesis that activation of the proximal musculature of the hemiplegic right arm in the production of a pointing gesture would differentially facilitate confrontation naming in anterior, nonfluent aphasics. The Broca's, global, transcortical motor, and anomic aphasics collectively represented the nonfluent group in this study, based on the criteria described above. The Wernicke's aphasics were not expected to benefit from this gestural technique.

On this hypothesis the three gestural conditions comprised the independent variables. The differences on the response measure of naming accuracy among these three conditions (i.e., proximal right pointing vs. proximal left pointing, proximal right pointing vs. distal right flexion, and proximal left pointing vs. distal right flexion) represented the dependent variables. The two major diagnostic groups (i.e., anterior vs. posterior aphasics) were compared on these differential performance measures. This was accomplished by comparing the

collective anterior group, consisting of the Broca's, global, transcortical motor, and anomic patients (i.e., all subjects demonstrating evidence of anterior brain damage), with the Wernicke's patients. Group differences were assessed on these differential performance measures via t tests. Considering the size of the groups, nonparametric statistics, specifically Mann-Whitney U tests were also completed.

It was predicted that the degree of differential effect would progress linearly according to diagnostic subtype. This entailed a progression from the level of the Wernicke's patients who were not expected to reveal a differential effect, through the globals, frontal anomics, and transcortical motor aphasics, to the Broca's patients, who were predicted to demonstrate the strongest differential effect. An analysis of variance was completed to assess for a linearity effect. On this model a Kruskal-Wallis one-way analysis of variance was also computed to assess the difference among the five subgroups. All possible pairwise comparisons were then conducted using the Mann-Whitney U test.

Additionally, Pearson correlation coefficients were computed to assess the interrelationships among the following: the differential gesture/naming variables; performance on each of the experimental gesture/naming conditions; demographic variables, including age, sex, level of education, time since onset, severity of

hemiplegia and aphasia; and variables derived from mean performance on each of the subtests of the Western Aphasia Battery and the Boston Naming Test.

Table 1

Age, Education, Time Since Onset, and Severity (AQ)

	N	Mean Age	Mean Yrs. of Education	Mean Mos. Since Onset	Mean (AQ)
Broca	8	63	14	45	52.3
Wernicke	6	65	14	50	39.8
Global	4	60	15	65	34.3
TC Motor	4	65	11	37	75.0
Anomic	2	73	15	44	85.2

Note. Maximum AQ score (normal performance) = 100.

Table 2

Gesture/Naming Stimuli and Standard Frequency Indices (SFI)

	Stimulus Word	SFI	Stimulus Word	SFI
Set A:	Horse	63.2	Camera	53.9
	Eggs	61.0	Closet	50.5
	Onion	45.2	Television	58.6
	Chicken	55.7	Gloves	49.2
	Truck	58.7	Letter	63.8
	Potato	53.3	Necklace	48.8
	Lettuce	47.7	Razor	43.7
	Sheep	59.1	Rug	51.5
	Sandwich	49.9	Couch	47.1
	Airplane	57.1	Belt	54.6
	Lemon	47.2	Glasses	53.8
	Butterfly	50.8	Towel	48.9
	Bicycle	54.8	Stove	54.8
	Sweater	49.1	Door	64.6
	Skirt	50.2	Shower	48.4
	Spider	54.8	Tea Kettle	44.6
	Hat	59.2	Fork	51.9
	Flashlight	51.1	Blanket	55.0
	Coat	58.0	Lipstick	39.8
	Brush	54.9	Toaster	39.3
	Radio	59.8	Bathtub	46.2
	Screwdriver	40.6	Comb	50.1
	Piano	55.1	Money	64.9

Table 2 (Continued)

	Stimulus Word	SFI	Stimulus Word	SFI
Set B:	Boat	62.1	Watch	62.5
	Cup	56.7	Thermostat	42.6
	Mousetrap	38.4	Cat	60.2
	Oven	52.0	Perfume	49.5
	Pear	46.5	Brush	54.9
	Doughnuts	45.2	Soap	53.5
	Grapes	51.1	Carrots	48.2
	Glass	62.0	Refrigerator	50.5
	Suitcase	47.2	Lamp	54.9
	Shoes	59.1	Spoon	49.0
	Purse	49.4	Toilet	42.6
	Boots	54.6	Window	61.8
	Dog	63.6	Hammer	53.1
	Van	46.9	Clock	57.4
	Sink	54.0	Matches	52.3
	Chair	58.7	Bus	57.7
	Dresser	45.5	Cow	56.7
	Steak	46.2	Corn	59.8
	Broom	50.8	Orange	55.6
	Goat	53.1	Rabbit	55.4
	Rake	47.0	Socks	50.3
	Robe	47.1	Washcloth	36.6
	Tie	56.2	Wallet	41.5

Table 2 (Continued)

	Stimulus Word	SFI	Stimulus Word	SFI
Set C:	Car	64.8	Dress	58.0
	Table	64.2	Frog	54.2
	Mop	42.4	Iron	60.9
	Pot	54.4	Mailbox	39.8
	Fence	57.6	Pancakes	44.1
	Banana	49.7	Pliers	40.2
	Picture	66.0	Bacon	50.7
	Keys	51.7	Cookies	53.8
	Cane	52.4	Slip	53.8
	Ring	59.7	Knife	57.4
	Duck	55.5	Scale	59.3
	Thermometer	52.8	Calendar	49.7
	Pants	50.2	Motorcycle	43.3
	Shovel	49.6	Slippers	47.5
	Train	59.9	Chicken	55.7
	Phonograph	47.6	Jacket	53.3
	Pen	55.0	Earrings	44.4
	Bowl	57.1	Umbrella	48.6
	Vacuum	51.7	Razor	43.7
	Dishwasher	36.7	Nails	54.3
	Apple	57.2	Shirt	55.6
	Bucket	52.6	Deer	57.3
	Pillow	50.6	Bird	61.6

Chapter IV

Results

The intention of this study was to determine if certain unilateral gestural movements, produced simultaneously during attempts at oral-verbal expression, would differentially affect the expressive capacity of severely aphasic patients. Specifically, the primary contention, developed on the hypothesis outlined above, held that communicative gestures produced through neuromotor activation of the proximal (i.e., shoulder) musculature of the right hemiplegic limb of nonfluent, anterior aphasics would differentially facilitate visual confrontation naming performance. The experimental gesture/naming procedures were developed to evaluate the differential effect of right proximally driven gestures, relative to left-sided proximally driven gestures, as well as right-sided distal activation (i.e., finger flexion or clenching of the fist). The findings on the three gesture/naming conditions will be subsequently discussed at length.

In addition to the experimental gesture/naming procedures, all 24 patients were assessed on an independent measure of naming ability (i.e., Boston Naming Test), from which a score of 35 or less was established as criterion for inclusion in the study. The mean score on

the BNT for the entire sample was 14.2, with a range of 2 to 35. Of the diagnostic subgroups, the mean score on the BNT for the Wernicke's aphasics was 9.3, with a range of 2 to 28. The mean performance of the Broca's patients was 17, with a range of 3 to 30, and the mean score of the transcortical motor aphasics was 24 with a range of 13 to 35. The mean score of the global aphasics was 4, with a range of 3 to 6. The mean performance of the two anomic cases was 21. When combined to form a collective diagnostic group based on anterior pathological involvement, the latter four subgroups (i.e., Broca's, transcortical motor, global, frontal anomic) generated a mean BNT score of 15.8, with a range of 3 to 35.

All 24 patients were evaluated on the Western Aphasia Battery (WAB) in order to determine and/or confirm diagnostic subtype. The eight subtest sections of the WAB consist of the following: 1. Spontaneous Speech, 2. Auditory Verbal Comprehension, 3. Repetition, 4. Naming, 5. Reading, 6. Writing, 7. Apraxia, 8. Constructional, Visuospatial, and Calculation Tasks. A listing of the subtest sections with the individual subtests comprising the sections of Spontaneous Speech, Auditory Verbal Comprehension, Naming, and Constructional, Visuospatial, and Calculation Tasks is presented in Appendix A. The maximum scores for these subtests and sections, as well as the formulas for the severity measures (i.e., Aphasia Quotient and Cortical Quotient) are also noted in this

listing. Ratings on severity of aphasia together with other descriptive information on all 24 patients are presented in Table 3. Tables 4 and 5 provide further information regarding individual patient performance on the WAB subtests and the mean scores of the diagnostic subgroups, respectively.

The results of the three gesture/naming procedures essentially support the hypothesis that pointing or deictic gestures produced through activation of the proximal musculature of the right hemiplegic arm of nonfluent aphasics differentially facilitates naming ability. Although there was considerable variability in naming performance between and within subgroups, these differences were not unexpected in light of the wide variability in baseline naming performance, as established on the BNT. Despite such variance in naming ability, in the gesture/naming series a pattern emerged in which those patients manifesting the symptom complex characteristic of anterior or frontal involvement (i.e., nonfluent speech, hemiplegia) revealed this differential effect on naming performance. Conversely, this effect was generally not demonstrated by the temporal lobe or Wernicke's aphasics.

The differential effect of right proximal versus left proximal gesturing on naming performance was significantly greater for the anterior aphasics ($M = 5.39$) than the posterior aphasics ($M = 1.33$), $t(22) = 2.59$, $p < .02$. Due to the size of the subgroups, this difference was also

assessed on a nonparametric test which confirmed the significance of the differential effect, Mann-Whitney $U = 18$, $p < .02$.

Interestingly, among the anterior aphasics, naming performance on the control condition of right distal activation commonly, though not invariably, fell between the performance levels of the two proximal gestural conditions. No such pattern was demonstrated by the Wernicke's patients. Similar to the differential finding of the right proximal condition relative to the left proximal condition, the differential effect of right proximal gestures versus right distal activation on naming was significantly greater for the anterior aphasics ($M = 4.22$) than the posterior aphasics ($M = -0.33$), $t(22) = 2.47$, $p < .05$. Nonparametric statistical analysis confirmed the significance of this differential effect as well, Mann-Whitney $U = 22$, $p < .05$. Incidentally, there was no significant difference between the anterior aphasics ($M = 1.17$) and the posterior aphasics ($M = 1.67$) on the left proximal versus right distal differential performance measure, $t(22) = -.29$, $p = .78$ (Mann-Whitney $U = 53.5$, $p = .97$).

Among the anterior patients, t tests were conducted to assess for the possibility of a difference between those patients assessed on the direct order (ABC) and those assessed on the counterbalanced order (CBA), for both the right proximal/left proximal and the right

proximal/right distal differential measures. There was no significant order effect for either of these differential performance measures. With respect to the right proximal/left proximal measure, $t(16) = -.07$, $p=.94$, while for the right proximal/right distal measure, $t(16) = -.74$, $p=.47$. Further information on individual patient performance in the three gesture/naming conditions is presented in Tables 6 and 7.

Considering the difference in baseline naming performance between the anterior aphasics ($M = 15.8$) and the posterior aphasics ($M = 9.3$), as established on the Boston Naming Test, there was concern that this difference in baseline naming level may have influenced the differential performance measures. However, the correlation between the BNT and the right proximal/left proximal difference was insignificant, $r(22) = .20$, $p=.17$. The correlation between the BNT and the right proximal/right distal difference was also insignificant, $r(22) = .22$, $p=.14$. Furthermore, an analysis of variance was computed for the anterior and posterior aphasics on the right proximal/left proximal difference, with the BNT as a covariate, which revealed an insignificant F value, $F(1, 22) = 1.15$, $p=.29$.

The data representing the difference in naming accuracy between the right proximal and left proximal gesture conditions suggested that this differential effect increased in an ordinal or linear fashion according to

aphasic subtypes. On this model it was predicted that the Wernicke's aphasics would demonstrate no differential effect and the Broca's aphasics would reveal the strongest differential effect, with the global aphasics, frontal anomics, and transcortical motor aphasics generating an increasing differential effect, respectively. An analysis of variance confirmed this prediction, indicating a significant linearity effect, $F(4, 19) = 7.88, p < .05$.

The five aphasic subgroups generated the following mean ranks: (Broca's, 16.50), (Transcortical Motor, 12.50), (Frontal Anomic, 13.75), (Global, 12.88), (Wernicke's, 6.50). Although all of the subgroups did not differ significantly among themselves as determined from a Kruskal-Wallis one-way analysis of variance, chi-square $(4, N = 24) = 7.05, p = .13$, this was not surprising in light of the consistency of the anterior subtypes in generating the differential (right proximal/left proximal) effect, relative to the posterior aphasics. However, pairwise comparisons using the Mann-Whitney U test revealed that only the Broca's and Wernicke's subgroups differed significantly on the right proximal versus left proximal differential effect, $U = 8.0, p < .05$. Additionally, only the Broca's and Wernicke's subgroups differed significantly on the right proximal versus right distal differential effect, $U = 6.0, p < .05$.

Table 8 presents the patient information on those subjects who generated the strongest right proximal/left

proximal differential effect on naming performance. Two notable outliers, including one Broca's aphasic and one Wernicke's aphasic, who did not conform to the overall pattern of differential effect deserve special mention.

One Broca's aphasic demonstrated no differential effect between the right proximal and left proximal gesture/naming conditions. This 78 year old man was severely aphasic, but was also markedly dysarthric which further restricted his naming performance. Additionally, unlike all of the other spastic hemiplegics in the sample who had retained at least limited range of motion, this patient was characterized by severe flaccid hemiplegia with negligible range of motion.

One Wernicke's aphasic demonstrated a relatively strong differential effect in favor of the right proximal gesture/naming condition. Unlike the other Wernicke's patients, this man's auditory-verbal comprehension was comparatively well preserved, and in fact as described previously, his comprehension score on the WAB overlapped with those of the Broca's subgroup. Furthermore, in contrast to the rest of the Wernicke's subgroup, this patient had right hemianesthesia, suggestive of parietal lobe involvement.

Figure 1 illustrates the relative mean performance of the five aphasic subgroups across the gesture/naming conditions. Figure 2 illustrates the difference in mean

performance between the anterior and posterior aphasic subgroups across the gesture/naming conditions.

Pearson correlation coefficients were completed for all combinations among the gesture/naming conditions, the gesture/naming differentials, the demographic variables, all WAB subtest scores, and the BNT. These intercorrelations were computed for the entire aphasic sample, as well as the anterior aphasics, independently. As expected, all three gesture/naming conditions were directly related to the capacity for expressive speech, particularly spontaneous speech and naming. These relationships did not differ between the anterior subgroup and the total aphasic sample.

For example, the following correlation coefficients were computed for the Boston Naming Test scores and the individual gesture/naming scores. Among the anterior aphasic subgroup these correlates were (right proximal) $r(16) = .90$, (right distal) $r(16) = .86$, and (left proximal) $r(16) = .89$, for all of which $p < .001$. Among the entire aphasic sample these correlates were (right proximal) $r(22) = .90$, (right distal) $r(22) = .85$, and (left proximal) $r(22) = .88$, for all of which $p < .001$.

With regard to the gesture/naming differentials, the correlation of the right proximal/left proximal differential and the Raven's Colored Progressive Matrices score approached significance, $r(15) = -.37$, $p = .07$ for the anterior subgroup only. However, the predictive value of

this correlate was diminished by the additional relationship between the right distal/left proximal differential and the Raven's Colored Progressive Matrices score, $r(15) = -.39$, $p=.06$.

Surprisingly, among the demographic variables, education was directly related to the right proximal/right distal differential, $r(22) = .39$, $p<.05$. But more importantly, among the anterior subgroup this relationship was found to be considerably stronger, $r(16) = .72$, $p<.001$. However, the right proximal/left proximal differential was not related to level of education, $r(16) = .23$, $p=.18$. Interestingly, among the anterior subgroup only, an inverse relationship between time since onset and the right proximal/left proximal differential was nearly significant, $r(16) = -.39$, $p=.06$. Additionally, the inverse relationship between the right proximal/right distal differential and time since onset reached significance, $r(16) = -.49$, $p<.05$.

Based on the correlative findings of a related study by Brown, et al. (1983), the relationship between the proximal gesture/naming differential and both severity of hemiplegia and severity of aphasia were of particular interest, with respect to the anterior aphasic subgroup. However, neither the severity of hemiplegia, $r(16) = .15$, nor the severity of aphasia (derived from Aphasia Quotients), $r(16) = .12$, were correlated with the right proximal/left proximal differential.

Table 3

Patient Information on 24 Aphasic Patients Serving as Subjects

Patient	Diagnostic Group	Severity	Age	Sex	Education (years)	Time Post-Onset (months)
1	Global	Severe	58	M	16	68
2	Global	Severe	58	F	12	149
3	Global	Severe	72	M	13	34
4	Global	Severe	51	M	20	10
5	Broca's	Severe	56	F	16	19
6	TC Motor	Moderate	69	M	6	NA
7	Broca's	Moderate	51	M	12	83
8	Broca's	Moderate	63	M	9	69
9	Broca's	Moderate	69	F	12	22
10	Anomic	Mild	83	M	18	24
11	Broca's	Mild	64	M	21	24
12	Broca's	Moderate	68	M	14	15
13	TC Motor	Moderate	66	M	12	50
14	TC Motor	Moderate	63	M	12	9
15	Broca's	Severe	58	M	16	61
16	TC Motor	Moderate	63	M	12	53
17	Broca's	Severe	78	M	12	64
18	Anomic	Mild	64	F	12	65
19	Wernicke's	Severe	77	M	12	27
20	Wernicke's	Severe	61	F	12	16

Table 3 (Continued)

Patient	Diagnostic Group	Severity	Age	Sex	Education (years)	Time Post-Onset (months)
21	Wernicke's	Severe	56	F	20	28
22	Wernicke's	Severe	67	M	10	32
23	Wernicke's	Severe	53	M	20	115
24	Wernicke's	Moderate	77	F	12	82

Table 4

Scores of 24 Aphasic Patients on the Eight Subtest
Sections of the Western Aphasia Battery

Patient	1 SS	2 AVC	3 REP	4 NAM	5 READ	6 WRITE	7 APRAX	8 C/VS/C
1	5	119	2	5	0	30	60	68
2	4	144	28	23	33	26	53	54
3	5	112	12	19	39	23	48	42
4	4	147	13	7	44	11	58	70
5	9	156	6	6	49	19	41	62
6	13	197	100	34	68	61	60	63
7	12	164	66	35	65	34	57	93
8	15	200	42	38	71	50	60	90
9	12	164	86	37	67	51	51	63
10	19	200	100	48	100	100	60	77
11	16	200	NA	NA	NA	NA	NA	NA
12	12	174	32	46	66	67	60	73
13	13	196	100	44	79	83	59	95
14	12	200	100	58	60	51	60	78
15	10	148	36	52	44	37	48	73
16	13	200	100	59	100	76	60	87
17	2	195	4	14	53	47	58	92
18	18	200	80	54	93	77	59	91
19	13	92	42	18	29	14	54	53
20	14	124	38	25	37	20	48	48
21	14	93	NA	NA	NA	NA	NA	NA

Table 4 (Continued)

Patient	1 SS	2 AVC	3 REP	4 NAM	5 READ	6 WRITE	7 APRAX	8 C/VS/C
22	6	137	8	6	48	17	55	77
23	13	154	16	20	72	51	57	96
24	15	136	42	49	61	67	56	73

Table 5

Mean Performance of the Aphasic Subgroups on the Western
Aphasia Battery Subtest Sections

Aphasic Subtype	1 SS	2 AVC	3 REP	4 NAM	5 READ	6 WRITE	7 APRAX	8 C/VS/C
Broca's	11	175	39	33	59	44	54	78
Wernicke's	13	123	29	22	49	34	54	69
Global	5	131	14	14	29	23	55	59
TC Motor	13	198	100	49	77	68	60	81
Anomic	19	200	90	51	97	89	59	84

Table 6

Number of Items Correctly Named by 24 Aphasic Patients
Serving as Subjects

Patient	Aphasic Subtype	Condition 1	Condition 2	Condition 3
1	Global	11	5	6
2	Global	12	11	10
3	Global	14	12	8
4	Global	15	5	12
5	Broca's	15	7	6
6	TC Motor	26	25	20
7	Broca's	34	31	29
8	Broca's	34	29	29
9	Broca's	37	33	31
10	Anomic	38	33	31
11	Broca's	38	25	32
12	Broca's	41	28	33
13	TC Motor	41	39	36
14	TC Motor	43	39	40
15	Broca's	43	39	33
16	TC Motor	44	40	41
17	Broca's	6	7	6
18	Anomic	43	45	41
19	Wernicke's	27	35	29
20	Wernicke's	26	22	25
21	Wernicke's	6	9	7

Table 6 (Continued)

Patient	Aphasic Subtype	Condition 1	Condition 2	Condition 3
22	Wernicke's	11	10	10
23	Wernicke's	21	19	12
24	Wernicke's	44	42	44

Table 7

Percentage of Items Correctly Named in Three Gesture/
Naming Conditions by 24 Aphasic Patients

Patient	Aphasic Subtype	Condition 1	Condition 2	Condition 3
1	Global	23.9	10.9	13.0
2	Global	26.1	23.9	21.7
3	Global	30.4	26.1	17.4
4	Global	32.6	10.9	26.1
5	Broca's	32.6	15.2	13.0
6	TC Motor	56.5	54.3	43.8
7	Broca's	73.9	67.4	63.0
8	Broca's	73.9	63.0	63.0
9	Broca's	80.4	71.7	67.4
10	Anomic	82.6	71.7	67.4
11	Broca's	82.6	54.3	69.6
12	Broca's	89.1	60.9	71.7
13	TC Motor	89.1	84.8	78.3
14	TC Motor	93.5	84.8	86.9
15	Broca's	93.5	84.8	71.7
16	TC Motor	95.6	86.9	89.1
17	Broca's	13.0	15.2	13.0
18	Anomic	93.5	97.8	89.1
19	Wernicke's	58.7	76.1	63.0
20	Wernicke's	56.5	47.8	54.3
21	Wernicke's	13.0	19.6	15.2

Table 7 (Continued)

Patient	Aphasic Subtype	Condition 1	Condition 2	Condition 3
22	Wernicke's	23.9	21.7	21.7
23	Wernicke's	45.6	41.3	26.1
24	Wernicke's	95.6	91.3	95.6

Table 8

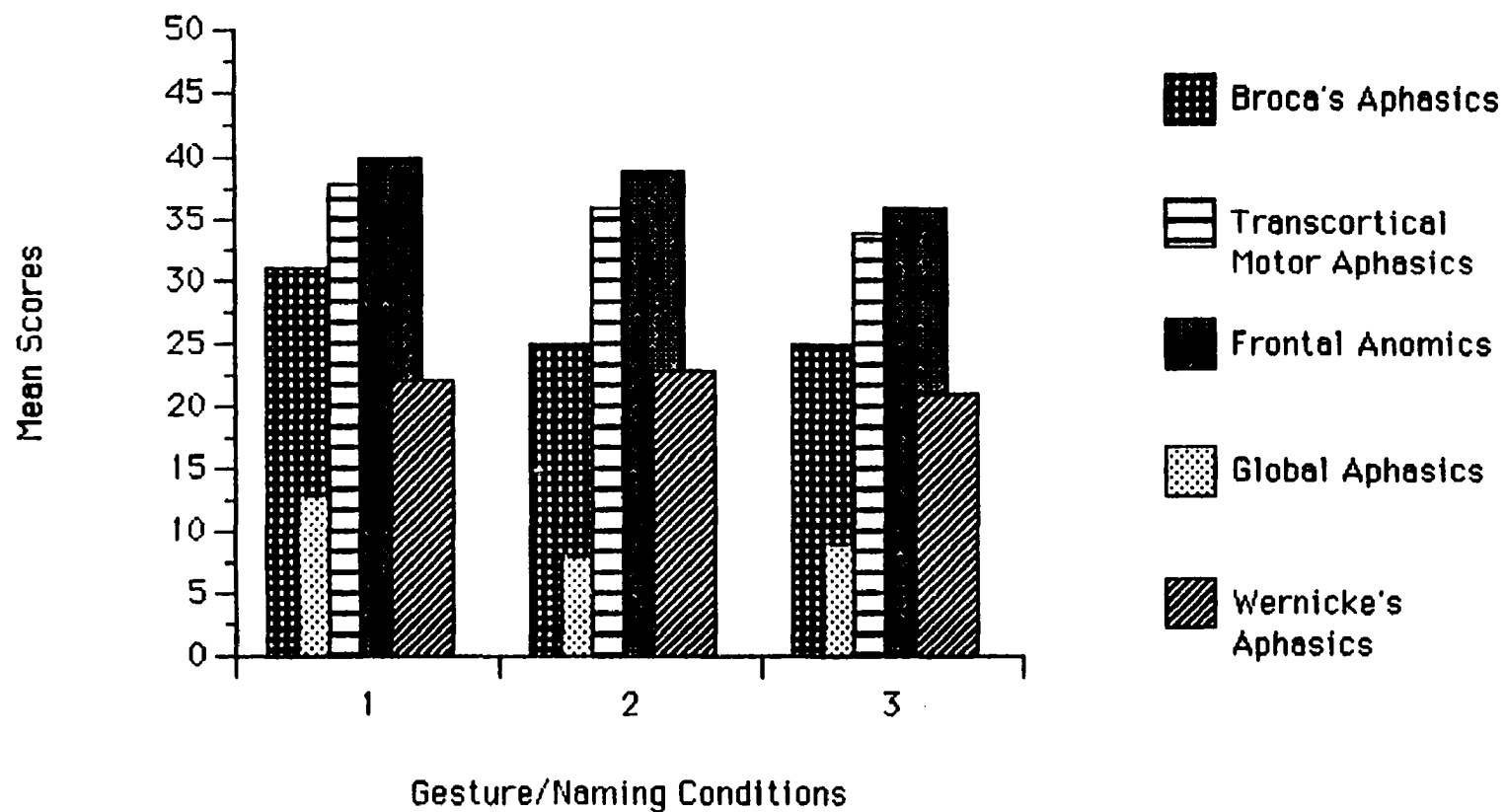
Patient Information on those Aphasics Demonstrating the
Strongest Right Proximal Gesture/Left Proximal Gesture
Differential Effect on Naming

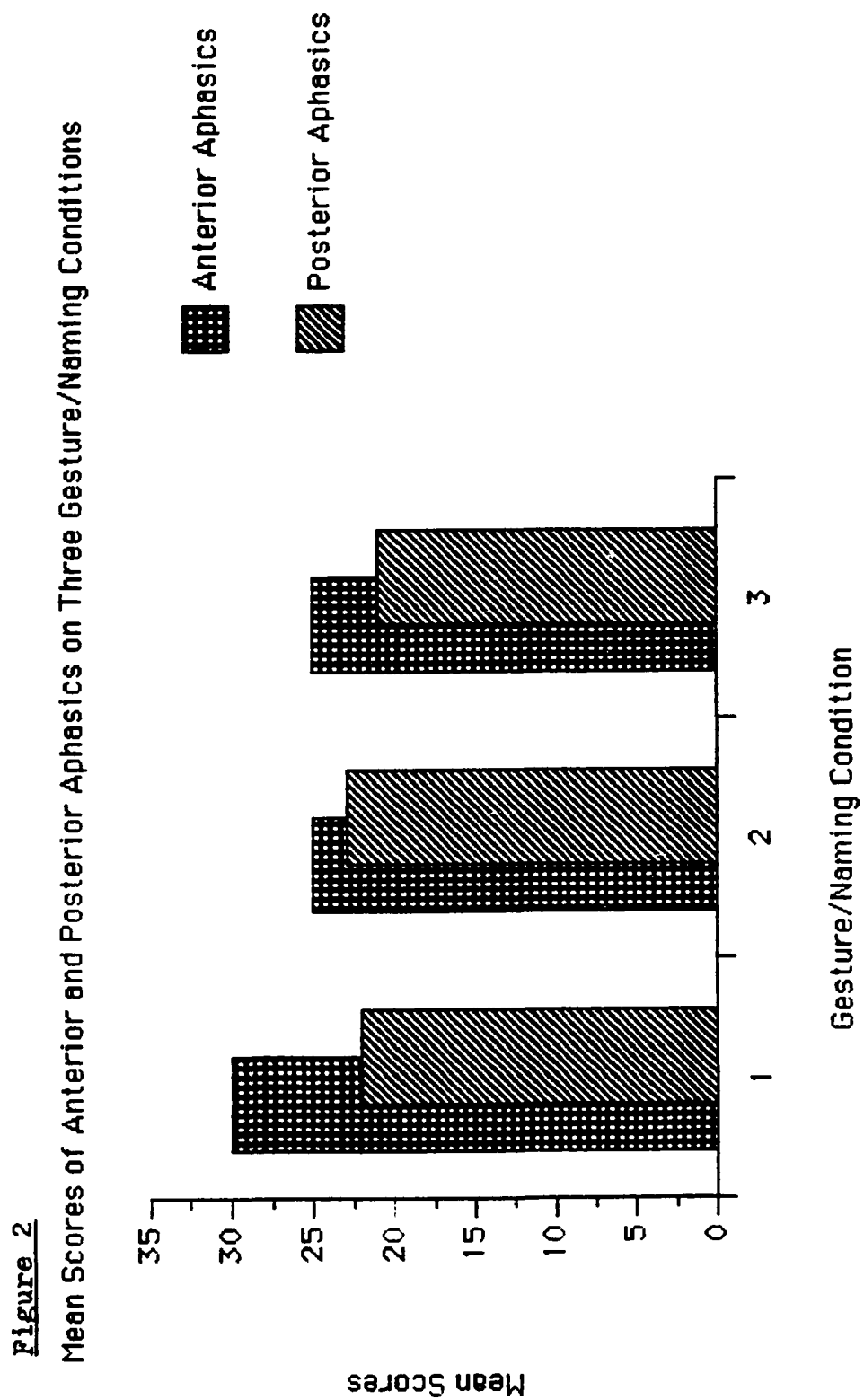
Patient	Diagnostic Group	Severity	Age	Sex	Differential Effect (Con.1 - Con.3)
1	Global	Severe	58	M	5
3	Global	Severe	72	M	6
5	Broca's	Severe	56	F	9
6	TC Motor	Moderate	69	M	6
7	Broca's	Moderate	51	M	5
8	Broca's	Moderate	63	M	5
9	Broca's	Moderate	69	F	6
10	Anomic	Mild	83	M	7
11	Broca's	Mild	64	M	6
12	Broca's	Moderate	68	M	8
13	TC Motor	Moderate	66	M	5
15	Broca's	Severe	58	M	10
23	Wernicke's	Severe	53	M	9

Note. The cut-off criterion established as representing a relatively strong differential effect was a difference of 5 items between Conditions 1 and 2, in favor of Condition 1.

Figure 1

Mean Scores of Five Aphasic Subtypes on Three Gesture/Naming Conditions





Chapter V

Discussion

These findings provide solid support for the contention that functional activation of the right arm in the production of communicative gestures favorably affects the naming capacity of nonfluent, anterior aphasics. More precisely, the production of deictic or pointing gestures through the activation of the proximal and axial muscle systems of the hemiplegic side appear to have a facilitatory effect on naming performance among the anterior aphasic subtypes. Moreover, the engagement of the proximal right brachial system differentially affected oral-verbal expression relative to comparable gestural activity of the motorically intact left arm and distal activation of the right hand, exclusively.

This differential effect on confrontation naming performance, however, was consistently demonstrated by those patients with evidence of frontal lobe pathology, and not by posterior or temporal lobe aphasics. Thus, patients manifesting the symptom complex characteristic of anterior involvement (i.e., nonfluent speech, articulatory difficulty, word finding difficulty, hemiplegia) typically produced this differential gestural effect on naming accuracy. Furthermore, although there was considerable variability in the strength of this differential effect

among the anterior aphasics, all of the subtypes with evidence of anterior lesions (i.e., Broca's, transcortical motor, frontal anomia, and global aphasics) generated the differential effect.

For the majority of these patients who were hemiplegic or hemiparetic, it was necessary to incorporate and elicit brain stem reflexes in order to enable them to at least approximate a pointing gesture with the paralytic right arm. The asymmetrical tonic neck reflex (ATNR), in particular, was utilized to temporarily reduce the flexor synergy of the spastic hemiplegia and stimulate extensor tone which facilitated the execution of the right proximally driven gestures. The ATNR is elicited by lateral rotation of the head which reflexively results in an increase in extensor tone in the extremities on the side toward which the face is turned, and a reciprocal increase in flexor tone throughout the extremities on the side toward which the occiput is turned.

Cailliet (1980), among others, has suggested that elicitation of such supraspinal reflexes, particularly in patients with dense spastic hemiplegia resulting from extensive cortical damage, may activate latent neuropsychological pathways, especially when incorporated within the context of an adaptive functional response. The lateral rotation of the head required to elicit the ATNR was effected by positioning the naming stimuli in the right peripheral visual field of the subjects, which

required them to turn in order to see the stimuli clearly. Such positioning of the stimulus photographs further enabled the hemiplegic patients to gesture in the actual direction of the pictures. This was due to the comparatively easier execution of lateral pointing than forward pointing, because even slight shoulder flexion typically reactivated the flexor synergy. Rotation of the trunk, in addition to the head in the more severely hemiplegic patients typically facilitated the execution or approximation of pointing gestures. The symmetrical tonic neck reflex was also incorporated with a few patients, but to a considerably lesser degree than the ATNR.

Overall, the finding on the differential effect of the gesture/naming procedures on naming performance suggests that there is some functional utility in the involvement of the hemiplegic or hemiparetic limb in simple, but communicative gestures during effortful attempts at verbal expression. However, such utility appears to be restricted to the aphasias resulting from frontal lobe lesions (viz., those aphasics with motoric dysfunction), excluding temporal lobe or Wernicke's aphasics. This finding is roughly consistent with Luria's (1970) proposition and the findings of Goodglass and Stuss (1979) and Kohn and Goodglass (1985) on the advanced potential of Broca's aphasics, relative to posterior aphasics, to benefit from external cues, particularly phonemic cuing in naming performance.

The significant ordinal effect which denoted a progressive increase in the differential gesture/naming effect according to diagnostic subgroup is intriguing. This effect represents a linear increase in the right proximal gesture versus left proximal gesture naming differential, from the level of the Wernicke's aphasics, who as a group revealed no differential effect, to the Broca's subjects, who consistently generated a significant differential effect. The global, frontal anomic, and transcortical motor aphasic subgroups all fell midway between the Wernicke's and Broca's subgroups with regard to the differential effect, and did not essentially differ from one another. Such findings lend credence to the microgenetic model of neurocognition, which holds that the process of cognitive formation, such as the selection, phonemic serialization, and vocal articulation of object names, unfolds over the neural levels which were laid down through the course of forebrain evolution (Brown, 1987).

Correlations between the right proximal/right distal differential and the demographic variables of time since onset of aphasia and level of education may provide the basic guidelines of prediction. The correlates suggest that these variables may be loosely considered as predictive indices of the potential for producing the facilitatory effect of right proximally driven gestures on naming. It should be noted that the right distal movement condition was included as a control measure to offset the

effect of left hemisphere activation in the right proximal gesture condition. Thus, the right proximal/right distal differential represented the difference in naming performance between an experimental gestural condition and control condition. The significant negative correlation, $r(16) = -.49$, $p < .05$, between the right proximal/right distal differential and the amount of time which had elapsed since the stroke and the concurrent onset of aphasia, suggests for the anterior aphasics, that patients with aphasia of relatively recent onset may be expected to benefit more from right proximal gestural activity than the more chronic cases.

On the other hand, the relation between the right proximal/right distal differential and level of education for the anterior aphasics, $r(16) = .72$, $p < .001$, suggests that the more educated these patients were, the more likely they were to differentially benefit from the right proximal pointing movements, with respect to naming capacity. Given the relative expansion of the lexicon which is implied by the education variable, this relationship is particularly compelling in light of the proposed facilitatory effect of such gestural activity. In view of these relationships the type of patients who might be expected to benefit most from such gestural interventions would be as follows: Broca's aphasics with nonfluent, effortful speech, and spastic hemiplegia, who

were relatively well educated and are two years or less post-onset.

That severity of aphasia and severity of hemiplegia were not significantly related to the differential effect of right proximal gesturing on naming was surprising in light of the finding of such relationships by Brown, et al. (1983) in a study of hemiplegic writing with global aphasics. However, the lack of such relationships may be considered encouraging in that the facilitatory effect of this gestural intervention does not appear to be restricted to only the most severely aphasic patients. In fact this intervention may be as beneficial to moderately aphasic nonfluent patients. Additionally, the neuromotor activation required to produce communicative pointing gestures appears to be effective with both hemiplegic, as well as the comparatively milder hemiparetic patients.

With regard to hemiplegia, it is suspected that patients may need to have evolved through the flaccid stage of paralysis in order to benefit from this technique. This suspicion is based on the performance of the single Broca's patient who had flaccid hemiplegia, and who produced no differential gesture/naming effect, in addition to the fact that flaccid hemiplegics, in contrast to spastic hemiplegics, are too motorically dysfunctional to even approximate the required gestural movement.

Clinical Implications

The clinical implications of these findings on the differential gestural facilitation of naming performance would appear to be rather straightforward. The various subtypes of anterior aphasics have all been shown to demonstrate this differential effect to varying degrees. Conversely, posterior aphasics, namely Wernicke's aphasics, seem in general to be linguistically unaffected by such self-generated communicative gestures.

Among the anterior aphasics, the Broca's subjects consistently produced the strongest differential gestural effect on naming ability. Although the frontal anomic, transcortical motor, and global aphasic subgroups demonstrated this differential effect, they typically produced the effect with less consistency and/or less strength than the Broca's aphasics, as a group.

In light of such an apparent dissociation, this gestural intervention technique should be encouraged as an adjunct to conventional speech therapy procedures, with anterior aphasics, and particularly Broca's aphasics during attempts at word finding. Furthermore, engagement of the hemiplegic limb in purposeful, adaptive movement may serve to detract from the common perception of the limb as nonfunctional and useless.

Theoretical Implications

The finding of the differential gestural facilitation of oral naming may be explained on the hierarchical process model of microgenesis. The nature of this differential effect, specifically the differential influence on naming performance of right proximal versus left proximal gestures, as well as right proximal versus right distal movements, suggests the possibility that functional activation of the right proximal limb musculature in the execution of communicative gestures may permit access to submerged levels of language processing in the damaged left hemisphere. Brown, et al. (1983) proposed a similar explanation for the finding that global aphasics with spastic right hemiplegia could write to dictation with the aid of a prosthetic device, driven by the residual proximal musculature of the paralytic limb, although agraphic with the motorically intact left hand.

Microgenesis refers to the structural development of a cognition (idea, percept, act, word) through a series of qualitatively different stages, which unfold following the presentation of a stimulus, to a behavioral response. This microtemporal approach incorporates the Jacksonian principle of hierarchical organization within the stage model of microgenetic progression.

The original microgenetic concepts evolved from the introspectional and gestalt movements around the turn of the century. Influenced by the Wurzbürger proposals on

the dynamic nature of imageless thought and the transitional stages of thought formation, Pick (1913, 1931) proposed multi-stage theoretical models of language production based on temporal hierarchies. Similarly, Sander (1928) outlined a theory of perception, or perceptual microdevelopment, in which the process of perception progressed from an initial stage of a diffuse, undifferentiated percept through subsequent stages of differentiation and discrimination, leading to a distinct configuration.

Heinz Werner (1956) is credited with coining the term "microgenesis" as an approximate English translation of the German term, *Aktualgenese* (momentary genesis), in a seminal paper on the microdevelopmental aspects of aphasic symptomatology. With regard to aphasic speech, Werner delineated two fundamental microgenetic principles: The functions underlying pathological manifestations are no different from the functions underlying intact or normal behavior, and all forms of cognition represent an unfolding process which progresses in developmental sequence. Other microgenetic theorists include Yakovlev (1948), Schilder (1951), Flavell and Draguns (1957), and Smith (1984).

Brown (1977, 1988) has expanded upon the psychological principles of microgenetic theory by providing a neurological framework through which this process unfolds. This structural model of neurocognition

holds that the symptoms of brain damage represent the premature exposure of preliminary levels which are normally exceeded and transformed in the process of cognitive formation. On this view, the neurocognitive process unfolds in a uni-directional (bottom-up) progression traversing neuroanatomical levels and cognitive stages in a manner which recapitulates the course of forebrain evolution.

With regard to the findings of the present study, one possible explanation of the neurolinguistic facilitation is that the engagement of the older proximal motor system of the right arm (left hemisphere), in the volitional production of an expressive movement (pointing gesture), enables anterior aphasic patients to access sub-surface levels of language processing. As in the case of hemiplegic writing, "the resultant loss of surface processing in both action and language representation permits access to submerged preprocessing stages in both of these systems (Brown, 1983, p. 213).

Supplementary support for the contention that right-sided gestural activity, particularly movements driven by archaic neuromotor systems, may influence speech mechanisms, is provided by the anthropological data on the evolution of communication. One major school of thought in this area holds that the vocal/language system of communication arose from and was preempted by a gestural communication system. Hewes (1973), among others, has

proposed that such a visual communication system evolved when the australopithecines first hunted in bands. Evidence for this view comes from findings revealing the phylogenetically early use of tools, as well as a right manual preference for their use, by *Australopithecus* (Dart, 1949). While it is known that these hominids walked upright, which freed their arms from locomotor activity, Kimura (1979) has noted that the findings of such tool use suggest that they "had the precision of upper limb movement control, which would make gesturing possible (p. 202). Furthermore, Lieberman (1975) has determined that the evolvement of a vocal tract capable of producing perceptually distinct vowel sounds did not occur until much later (*Homo erectus*).

Alternatively, a case could be made for explaining the finding of gestural facilitation of naming ability on Luria's (1963) model of neuropsychological rehabilitation. Founded on the theory of the dynamic localization of psychological functions, which holds that such functions are in actuality "complex dynamic systems fulfilling a purpose and realized by a working constellation of collaborating zones" (Luria, Naydin, Tsvetkova, & Vinarskaya, 1969, p. 381), Luria (1963) proposed a model of neuropsychological restoration based on the "reorganization of functional systems" (p. 32). Following the original work of Anokhin (1947) on the concept of functional systems and the dependence of a functional

system on the integrity of its afferent field, combined with the idea of mobile psychological systems, as originated by Vygotsky (1934), Luria outlined the properties of these complex dynamic systems.

During the course of evolution of the brain, different structural levels were laid down which were dependent upon and corresponded to different afferent fields. These various phylogenetic levels of neural organization and integration provide the foundation on which various types of compensation and reorganization may be effected following brain damage. Additionally, these functional systems undergo further differentiation and reorganization during the course of ontogenesis, providing still more of the so-called "background" levels which may serve to replace a primary level in the process of functional reorganization.

Three main types of reorganization of functional systems were delineated (Luria, 1963). The first of these is referred to as a form of intra-systematic reorganization which occurs automatically. This type of process is exemplified by cases in which following the onset of hemiplegia, the comparatively preserved proximal motor system begins to be utilized to compensate for distal functions. Damage to secondary cortical integration areas requires intra-systematic reorganization of a second type, that of conceptual reorganization. Interventions of this type may be exemplified by the case

of simultaneous agnosia, in which the perceptual field may essentially be widened by restructuring the visual elements into semantically based groups, such as words. Finally, the third type involves inter-systematic reorganization. The classic example of this type is that of the Parkinson's patient with a severely dysfunctional gait, who may demonstrate markedly improved walking ability following the incorporation of the visual system, by being required to step over lines drawn on the floor.

With regard to the present study, the execution of a communicative gesture which functions to locate the to-be-named item in space may be considered to inter-systematically facilitate the utterance of the object's name. Additionally, the neuromotor activation of the gestural movement may also function to intra-systematically counteract the pathological inertia commonly associated with anterior aphasia.

The concept of "deblocking" which was introduced and elaborated by Egon Weigl (1981) represents an additional alternative to the model which has been proposed to explain the present findings. Founded on the view that higher cortical functions arise from dynamic neuropsychological systems (Luria, 1966), Weigl believed that neuropathology, in effect, disrupts the interconnections of these psychological systems, resulting in the blocking of the normal systemic flow of cognitive processes. He suggested that certain methods or

techniques may serve to deblock a given disrupted function in a manner similar to Luria's (1963) theory of the reorganization of functional systems.

On this view, Weigl proposed the following: "The disturbance occurring in brain-damaged persons of higher cortical performances of individual or several functions (syndromes), e.g., of the speech function, can be deblocked under certain experimental conditions to a greater or lesser degree (p. 27). He then outlined the basic conditions necessary for producing a deblocking effect. First of all, the patient must retain one or more intact channels or pathways, aside from the disrupted mode, of performance of a given function. In other words, the patient must retain an alternative or secondary system which is intact and capable of performing the functional behavior. Examples include the written expression of words which can not be expressed vocally and intact gestural expression following the loss of oral-verbal expression. Secondly, in order for an intact function to deblock a disrupted function, the performance of the function through the intact system must precede attempts to perform the function within the disturbed mode.

Third, as in Luria's (1963) concept of inter-systematic reorganization of functions, the deblocking agent does not necessarily have to be based in the same afferent system as that of the disrupted or blocked function (e.g., intact tactile recognition may

deblock audioperceptual or visuoperceptual dysfunction). Finally however, the disordered and intact functions must bear some relationship with respect to the adaptive properties of the functional behavior. Rao and Horner (1978) employed Weigl's concept of deblocking to explain the facilitation of verbal expression and comprehension in the case study of a global aphasic. They proposed that the extensive gestural behaviors of this patient functioned to deblock his severely disrupted verbal capacity, resulting in vocal elaborations of his gestural expressions. The concept of deblocking lends itself to an explanation of the gestural facilitation of naming, but it does not account for the differential effect of the right proximal gestures on naming, as the microgenetic model does.

Therapeutic Implications of the Microgenetic Model

In conclusion, the therapeutic implications and utilization of the microgenetic model as a model for neuropsychological rehabilitation should be briefly mentioned. The application of this hierarchically organized process approach to the therapeutic domain, specifically in aphasia rehabilitation, represents a marked departure from the conventional linguistic interventions. First of all, like Luria's approach, which is directed toward the reorganization of functions, the microgenetic approach is based upon a comprehensive and

unitary model of neuropsychology, rather than language, exclusively. The focus of intervention is on the facilitation of the transition between processing stages within the progression of cognitive formation. The microgenetic approach stresses activation of specific processing levels based on the determination of the stage at which the formative sequence is derailed, as reflected by error type or symptoms. Unlike the conventional approaches and interventions based on compensatory models, this approach allows the prediction of facilitatory effects based on a structural model of neurocognition.

With regard to the present study, the finding of the differential facilitation of naming in anterior aphasics via the execution of right-sided, proximally driven, communicative gestures utilizing the hemiplegic limb, constitutes the starting point for more extensive research on this phenomenon. In addition to the need for studies designed to replicate this finding, subsequent studies should be directed toward further specification of the parameters within which this differential effect may be elicited, as well as refinement of the gestural behavior or neuromotor activation necessary to produce this effect. Finally, further research should also be concerned with the effect on adaptive functioning of prolonged and concentrated training in the use of this technique, and the degree to which the resultant facilitatory effect may be generalized to social situations.

Appendix

Spontaneous Speech	
Information Content	10
Fluency	<u>10</u>
Total	20
Comprehension	
Yes/No Questions	60
Auditory Word Recognition	60
Sequential Commands	<u>80</u>
Total	
(Divide By 20 For AQ)	10
(Divide by 10 For CQ)	20
Repetition	<u>100</u>
Total	
(Divide by 10)	10
Naming	
Object Naming	60
Word Fluency	20
Sentence Completion	10
Responsive Speech	<u>10</u>
Total	
(Divide by 10)	10
Aphasia Quotient	
(Add Totals and Multiply by 2 for AQ)	

(Kertesz, 1982)

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