CICSD

Gestures Produced by Patients With Aphasia and Ideomotor Apraxia

Beth L. Macauley
Candace L. Handley
The University of Alabama, Tuscaloosa

It is estimated that there are 750,000 cases of new or recurrent strokes annually (National Stroke Association, 2002). Of the 750,000 people who suffer a stroke every year in the United States, approximately 590,000 survive, and of those that survive, two thirds are moderately or severely impaired (National Stroke Association, 2002). The impairments following stroke can affect self-help skills, behavior, communication, eating, and many other areas of independence.

Aphasia is the term used to describe acquired language impairments following stroke. LaPointe (2005) defined aphasia as "an acquired communication disorder caused by brain damage that impairs a person's ability to understand, produce, and use language" (p. 2). Besides cerebrovascular disease, aphasia can occur as a result of a traumatic brain injury, a brain tumor, or a brain abscess. The National Aphasia Association (1999) estimates that approximately 1 million people in the United States have acquired aphasia, of which the majority results from stroke.

ABSTRACT: This study examined the effects of aphasia and ideomotor apraxia on conversational gesture. Participants included 8 neurologically normal control participants and 12 participants having aphasia from a single left-hemisphere stroke. Testing included the Western Aphasia Battery (Kertesz, 1982), the Florida Apraxia Battery (Rothi et al., 1992), and scoring of conversational gesture. Statistical findings using a between-group analysis of variance revealed a statistically significant difference in quantity and type of gestures used between experimental and control participants. Within the experimental participants, there was a clear relationship between severity of aphasia and conversational gesture, but not between severity of ideomotor apraxia and conversational gesture. Therefore, severity of aphasia appears to be a better predictor than severity of ideomotor apraxia for the production of spontaneous gesture.

KEY WORDS: aphasia, ideomotor apraxia, gesture

Taxonomies of aphasia typically classify the subtypes of aphasia into fluent and nonfluent, depending on the individual's ability to produce speech. Patients with ease of articulation, phrases of moderate length, correct syntactical form, and appropriate stress and durational characteristics are labeled as fluent speakers. Despite the fluent speech, however, the patient may convey little relevant information. Nonfluent individuals are those who use very short phrases, possibly consisting of less than four words, with stereotypic utterances, poor grammatical form, and a lack of intonational variation. Despite the limited output of their speech, their content is usually rich. It may be easier to understand fluent versus nonfluent speech as a continuum rather than two separate entities.

Damage to different areas of the brain can result in fluent aphasia, including Wernicke's area, the primary auditory cortex, and portions of the second temporal gyrus and the angular gyrus, all being regions posterior to the central sulcus (Brookshire, 2003). Fluent aphasias can further be categorized into subtypes including anomic, conduction, Wernicke's, transcortical sensory, and transcortical mixed—all of which are differentiated by lesion site, as well as the patient's ability to comprehend written or spoken language, repeat verbal phrases, and name common objects.

In contrast to fluent aphasia lesions, lesions occurring anterior to the central sulcus cause nonfluent aphasias. Nonfluent aphasia subtypes include Broca's, transcortical motor, mixed transcortical, and global. These also are differentiated by lesion sites and the patient's ability to

1092-5171/05/3201-0030

comprehend spoken and written language, repeat verbal phrases, and name objects. Foundas et al. (1995) described the limited output of nonfluent speech as effortful, dysprosodic, and agrammatic, as well as having impaired articulation and containing short phrases.

In the early years of aphasia therapy, clinicians focused primarily on verbal output rather than other forms of communication. More recently, however, researchers are documenting the impact of nonverbal aspects of communication such as use of sign language, gestures, mimicry, and pantomime, and clinicians are targeting these behaviors in therapy (Chapey, 2001). According to LaPointe (2005), individuals with aphasia may communicate better than they talk. This may seem paradoxical, but whereas communication does involve the verbal act of “talking,” a better definition of communication would simply be the exchange of information between others and within ourselves. A competent speaker does not rely solely on the verbal form of communication, but is capable of giving and receiving messages using multiple methods. A competent speaker also makes up for deficits in certain modalities by using others (e.g., speech, gesture, writing).

According to Heilman and Valenstein (1997), approximately 95% of right-handed people have both language and skilled movement lateralized to the left hemisphere of their brain. Learned, skilled movements include writing, using scissors, and riding a bike. Because of the dominance of the left hemisphere for both functions, damage to the left hemisphere may affect the person’s ability to produce and comprehend language as well as his or her ability to produce and understand learned skilled movements, such as gestures. Disorders of learned skilled movements are labeled apraxia, and result from a disturbance in motor planning and execution (Heilman & Rothi, 1993). Apraxia is not caused by paralysis, muscle weakness, or a sensory loss, but can be considered more of a programming error following damage to the brain.

Borod, Fitzpatrick, Helm-Estabrooks, and Goodglass (1989) noted that both aphasia and apraxia are strongly associated with left-hemisphere pathology. Wolf, Kannel, and McGee (1986) stated that aphasia and apraxia co-occur with an incidence estimated at 50% to 80% of persons with aphasia, or 45,000–72,000 people per year. There are two subdivisions of apraxia: ideational and ideomotor.

- *Ideational apraxia* (IDA) occurs when knowledge of relationships between objects and their designed action or use is affected. Persons with IDA often exhibit a loss of basic knowledge in relation to tool functions and use. They also make frequent errors in tasks in which they are asked to match a tool (screwdriver) with the object on which it acts (screw).
- *Ideomotor apraxia* (IMA) impinges on one’s ability to carry out common, familiar actions on command, such as waving goodbye. Persons with IMA exhibit a loss of ability to carry out motor movements, and may show errors in how they hold and move the tool in attempting the correct function.

According to Raymer and Ochipa (1997), IMA is considerably more common than IDA. Two types of gestures are elicited from patients in testing for and differentiating between IMA and IDA: transitive and intransitive. Transitive gestures are those involving knowledge of tool use (i.e., show me how to use a comb to fix your hair); intransitive gestures are those that do not use a tool, but have communicative value or intent (i.e., show me “be quiet”). IMA is of great importance to persons with aphasia because it may hinder the acquisition of gesturally based alternative communication systems (Macauley, 1995; Rothi, 1995).

When people are unable to talk, they compensate by using other modes of communication, such as gestures. In other words, gestures can serve as an alternative way to communicate when speech is impaired. LeMay, David, and Thomas (1988) summarized the significance of gesture use as being not only a source by which information is conveyed during discourse, but also as a valuable way to display emotion and direct and guide the flow of conversation. In persons with severely disordered verbal output, the ability to communicate nonverbally through gesture greatly impacts the individual’s overall quality of life (Borod et al., 1989). Individuals frequently use gestures within discourse to convey meaning, add emphasis, and enhance conversation (Foundas et al., 1995). Both cognitive rehabilitation and speech therapy efforts have made the most of gesture use to facilitate and/or supplement the communication skills of patients with brain injuries (Chapey, 2001).

The research thus far on the relationship between aphasia and the spontaneous use of gesture in conversation has been mixed. Several investigators feel that a relationship between the two does in fact exist (Foundas et al., 1995). Glosser, Weiner, and Kaplan (1986) found that the quality of an aphasic person’s communication through gesture paralleled that of his or her verbal communication skills. Therefore, it can be expected that the type of aphasia a person has may affect or predict the quality and quantity of gestures he or she uses to communicate. LeMay et al. (1988) studied conversational gesture use by persons with aphasia during 20-min interviews. They found that nonfluent participants produced the fewest gestures. However, those gestures were the highest in quality or content. On the contrary, fluent participants produced more gestures, but of those gestures, a smaller percentage conveyed meaning. In other words, fluent participants produced more gestures, but the gestures did not help convey the message. The control participants, those without brain injuries, produced the least amount of iconic gestures (gestures with independent meanings such as “goodbye,” “ok,” and “hitchhike”). Participants with nonfluent aphasia also used the entire range of gestural communication with more variation of movement and posture than did fluent aphasic participants. However, research has not all had the same findings and conclusions. Pedelty (1987) compared the gesture production in persons with nonfluent aphasia and persons with fluent aphasia and found that the quality of the gestures varied but the amount of gesture between the two groups did not differ. Christopoulou and Bonvillian (1985) also found no obvious relationship between severity of aphasia and the quality and quantity of gestures produced between persons with nonfluent and fluent aphasia. They concluded that although previous studies documented impairment in both the gestural and language skills of persons with aphasia, the gestural skills were not as impaired as the language skills.

Because of the aforementioned differences in gestural ability and competence across persons with aphasia, questions have arisen as to the relationship of the language system in the brain and the production of different types of gestures. Foundas et al. (1995) hypothesized that gesture with content and meaning (i.e., emblems and icons that are also called orthographs or intransitive gestures) may be more closely related to the speech-language systems in the left hemisphere, whereas gestures not carrying specific meaning (i.e., kinetographs or “transitive” gestures) may be independent of the speech-language system. Because of the possible impact on therapy for persons with aphasia, it is of vital importance that the types of gestures produced by individuals with language impairments be further analyzed in order to understand the relationship between aphasia, IMA, and gestural communication.

Macauley (1995) described the types of gestures that were produced by individuals with aphasia (see Table 1, adapted from the system used by LeMay et al., 1988).

When the frequencies of all gestures were compared in one study, persons with nonfluent aphasia produced more gestures in each category than either the persons with fluent aphasia or the control participants (LeMay et al., 1988). LeMay et al. also found that hand gestures were used most frequently by persons with nonfluent aphasia and least frequently by non-brain damaged control participants. Emphasis and filler gestures, as well as diectic gestures, were used primarily by persons with nonfluent aphasia, whereas persons with either fluent or nonfluent aphasia used kinetographs considerably more than the non-neurologically impaired control group. LeMay et al. theorized that the increased use of ideographs by persons with nonfluent aphasia was due to filling speech time when word-finding difficulty arose. One possible explanation for the increased use of batons is that the persons with nonfluent aphasia are adding as much emphasis as possible to their limited speech output.

Because gestures are produced through the praxis system and are closely related to language production, it is possible that severity of IMA may affect gesture production in persons with aphasia. Foundas et al. (1995) stated that performance on praxis tests and measures of gesture production suggest that the praxis system may be as important as the language system in mediating spontaneous gesture. Borod et al. (1989) also noted that left brain damage may affect the ability to produce symbolic hand/arm gestures (limb apraxia) in addition to verbal language (aphasia). Forty-one persons with unilateral left-hemisphere strokes were evaluated in areas of gestural communication, limb praxis, aphasia severity, auditory comprehension, and nonverbal intelligence. Results indicated that limb apraxia correlated highly with aphasia severity, auditory comprehension, and use of gesture. In addition, use of gesture had an inverse correlation with severity of IMA in that persons with severe IMA had decreased ability to use gestures.

Feyereisen, Bouchat, Dery, & Ruiz (1990) reported that persons with nonfluent aphasia produce more gestures, as a compensatory strategy, than control participants. However, the effects of IMA on gestural communication was not analyzed because all participants in this particular study had only mild IMA as opposed to varying degrees of severity. Macauley (1995) found that participants with nonfluent aphasia and severe IMA produced fewer gestures than control participants and were unable to use gestures as a compensatory strategy during communication.

The validity of previous research on gesture production by persons with aphasia is affected by the lack of data on IMA. Although LeMay et al. (1988) did provide a classification system for types of gestures, the investigation included a limited number of participants and did not test

Table 1. Classification of gesture type by Macauley (1995).

Type	*Category*	*Definition*	*Definitions of subcategories*
Emphasis	Batons	Gestures that accentuate or emphasize speech, but are not related in content	
Filler	Ideographs	Gestures that fill time but are not related in content of speech	
Content	Diectic	Gestures such as pointing to a present object or person	
	Kinetographs	Gestures that depict movement (transitive)	
	Orthographs	Emblems or intransitive gestures	
	Pictographs	Pictures that describe or draw a referent. 3 types:	
			Descriptive–draws shape of referent
			Locative–refers/points in a direction or toward location of referent
			Quantitative–indicates size or quantity of referent

for IMA. Because of this, it is possible that the results may have been compromised by the participants' ability, or inability, to produce gestures as a result of apraxia. Therefore, the increased use of baton gestures by persons with nonfluent aphasia (compared to fluent) cannot be accounted for by either the type of aphasia or the severity of IMA in each participant. Most of the research to date that has been done on gestural communication by persons with aphasia has not taken the severity of IMA into consideration. Consequently, information on the relationship between IMA and aphasia and their contribution to gesture use is not fully understood.

Therefore, the purpose of this study was to examine the types of gestures produced by persons with nonfluent aphasia and IMA, and to compare them with those produced by nonneurologically impaired control participants. It is hypothesized that there will be a difference in the types of gesture produced by persons with nonfluent aphasia when compared to nonneurologically impaired control participants, and that gesture type will be affected by the severity of apraxia. The following study questions were posed:

- Do persons with aphasia differ from neurologically normal control participants in the types of gestures they produce during spontaneous conversation?
- Does the total number of gestures produced relate more to the Western Aphasia Battery score or the Florida Apraxia Battery score?

METHOD

Participants

Participants included 20 persons, 12 with aphasia following a single left-hemisphere stroke and 8 neurologically normal controls. All persons with aphasia were at least 1 month post onset of stroke and had no prior history of neurological disease. Participants were recruited from area hospitals, rehabilitation centers, and adult nursing facilities in Tuscaloosa, Alabama, and also through a rehabilitation center in Birmingham, Alabama, according to Institutional Review Board guidelines within an approved study. Hearing acuity was assessed as within functional limits, as evidenced by each person's ability to respond to normal conversation-level speech during testing. The 8 participants with no history of neurological involvement were taken from a previous study by Macauley (1995). All participants were right handed and were native English speakers.

The experimental participants consisted of 7 females and 5 males with an average age of 60 years and an age range of 45–86 years. The experimental participants reported an average 22 months post onset of stroke, with a range of 1 month to 70 months.

The control participants consisted of 2 females and 6 males with an average age of 67 years and an age range of 51–73 years. The average educational level of the control participants was 12 years, with a range of 10–13 years. Table 2 displays the experimental and control participants' biographical information.

Table 2. Biographical information for all participants.

	Age	*Sex*	*Years of education*	*MPO*
Experimental participants				
L1	45	F	15	1;4
L2	65	F	12	4;8
L3	64	M	8	0;1
L4	63	M	12	0;1
L5	65	M	12	0;1
L6	58	F	13	0;4
L7	52	F	14	1;5
L8	86	F	12	0;1
L9	54	F	12	1;11
L10	69	M	16	5;10
L11	45	F	16	3;0
L12	49	M	12	2;8
Average (Mean)	60	5 males 7 females	13	21;5
Control participants				
C1	65	M	12	
C2	72	F	12	
C3	70	F	12	
C4	71	M	10	
C5	73	M	10	
C6	64	M	13	
C7	67	M	12	
C8	51	M	12	
Average (Mean)	67	6 males 2 females	12	

Note. MPO = months post onset of stroke according to years;months.

Instrumentation

All participants were videotaped using a Panasonic video camera on TDK 2-hr videotapes. Videotapes were replayed on a Panasonic four-head VCR via a Quasar 27-inch TV.

Procedures

A battery of clinical assessment measures and procedures were administered to nonfluent aphasic persons and control participants to test the following:

Aphasia. Participants were administered the following portions of the Western Aphasia Battery (WAB; Kertesz, 1982): I. Spontaneous Speech, II. Auditory Verbal Comprehension, III. Repetition, and IV. Naming. The results were scored according to test guidelines and an aphasia quotient (AQ) was calculated. The AQ depicts severity of aphasia. The higher the AQ score, the less severe the aphasia; the lower the AQ score, the more severe the aphasia.

IMA. Participants were administered the Gesture-to-Command subtest of the Florida Apraxia Battery (FAB; Rothi et al., 1992) to assess the presence and severity of IMA. This subtest consists of 30 items that are pantomimed (gestured) with the hand ipsilateral to the lesion (in order to negate any effects of hemiparesis). The 30 commands consist of 20 that elicit transitive gestures, such as “show me how you would use a paintbrush to paint the wall,” and 10 that elicit intransitive gestures, such as “show me how you wave goodbye.” Participants were videotaped performing these gestures and then scored by two unbiased examiners. Items were scored on a correct/incorrect (+/–) basis.

An apraxia quotient (AxQ) was calculated for each participant as a measure of apraxia severity by dividing the number of gestures produced correctly by the total number of gestures possible (30).

Spontaneous gestures in conversation. Spontaneous gestures in conversation were assessed during a 10–20-min conversation between participant and examiner. The participants were told that the conversation was needed to assess their language skills. At the end of the conversation, participants were told that the gestures were also going to be studied and that, because natural, unconsciously produced gestures were needed, this was not revealed at the onset of the taping. No participants responded negatively to this additional information. A video camera was focused on each participant and used to record the entire conversation. A standard list of topics was used with all participants and included open-ended questions such as “Tell me about your children,” “If you could travel anywhere in the world, where would you go and why?” “Tell me something interesting about yourself,” and “What types of hobbies do you enjoy?”

Scoring of conversational gestures was analyzed according to the Macauley (1995) classification system. A gesture was defined as a discrete movement that ended when there was a discernible pause in the action (approximately 0.5 s).

Reliability

Two trained, unbiased judges scored data independently to document interjudge reliability. Each judge independently classified each gesture for type according to the above classification system. If a disagreement occurred during comparison of the two sets of data, the gesture was replayed until a consensus was reached in greater than 95% of instances.

RESULTS

The experimental participants had an average AQ on the WAB of 61.2, with scores ranging from 24.8 (severely nonfluent) to 93.1 (mildly nonfluent). The control participants had an average AQ of 99 on the WAB, with scores ranging from 98–100. The experimental participants scored an average AxQ of 63, with scores ranging from 27 (severe IMA) to 90 (normal IMA) on the FAB. The control participants’ FAB scores averaged 97, with scores ranging from 93 to 100.

Table 3 illustrates the AQ and AxQ scores for both the experimental and the control participants, as well as the mean scores for each.

Table 3. Comparison of aphasia quotient and apraxia quotient between experimental and control participants.

Participants	*Aphasia quotient*	*Apraxia quotient*
Experimental		
L1	81	33
L2	75.8	80
L3	93.1	90
L4	84.1	80
L5	52.6	27
L6	50.6	27
L7	24.8	40
L8	52.8	53
L9	76.7	83
L10	68.5	90
L11	48.3	73
L12	61.9	83
Mean score	61.2	63
Control		
C1	98	97
C2	99	97
C3	98	97
C4	98	93
C5	99	97
C6	100	97
C7	100	100
C8	100	97
Mean score	99	97

Note. Aphasia quotient is based on the Western Aphasia Battery; Apraxia quotient is based on the Florida Apraxia Battery.

Gestural Data From Spontaneous Conversation

During the conversational portion of the testing, the experimental and control participants’ gestures were counted and categorized by type according to criterion from Macauley (1995). Due to the differences in the lengths of conversation between the participants, the following steps were taken to convert the data to standard comparable measurements. The total number of gestures produced was divided by the seconds of conversation produced by each participant individually, and multiplied by 60 to obtain a gesture per minute (GPM) ratio.

$$\text{GPM} = \frac{\text{total \# of gestures}}{\text{total \# of seconds of turn of conversation}} \times 60$$

The experimental participants produced an average of 7.04 gestures per min; the control participants produced an average of 4.44 gestures per min. When each participants’ data were examined, the experimental participants had larger GPM ratios for baton, ideographic, diectic, kinetograph, locational, and quantitative gestures, and the control participants had larger GPM ratios for orthograph and descriptive gestures. Tables 4 and 5 display these data.

In order to answer research question two: “Does the total number of gestures relate more to the Western Aphasia

Table 4. Average and range of gestures per minute (GPM) for gesture type.

Type of gesture	*Average GPM*	
	Experimental participants	*Control participants*
Emphasis	4.002	2.470
Filler	0.882	0.230
Content	3.106	1.740
Total	7.041	4.440

Battery score or to the Florida Apraxia Battery score?", the scores from the WAB and the FAB were placed on a graph according to severity. No trends were noted in the data.

Statistics

Descriptive statistics were applied to evaluate the differences in the AQ scores, the AxQ scores, and the different categories of conversational gesture used between the two participant groups. Using a between-group ANOVA, the difference in the means of the AQ scores between the control and experimental participants was statistically significant, meaning that they had a significance of less than 0.05, $F(19, 1) = 25.616$, $p < 0.05$. The variation of AxQ scores between the two groups was also analyzed using an ANOVA and found to be statistically significant, with $F(19, 1) = 16.476$, $p < 0.05$. Both of these differences are to be expected given that the control group had no neurological impairments, as did the experimental group.

Using a between-group ANOVA, the gestures categories of emphasis (batons), fillers (ideographs), and content (diectics, kinetographs, orthographs, and pictographs) were also analyzed. The results were significant for filler, with $F(19, 1) = 5.860$, $p = .026$; content, with $F(19, 1) = 19.142$, $p = .000$; and total number of gestures, with $F(19, 1) = 6.598$, $p = .019$); but not significant for emphasis gestures, with $F(19, 1) = .960$, $p = .340$.

DISCUSSION

As suggested by the first research question, the types of gestures that were produced by the participants with

Table 5. GPM data for all participants.

Participants	*GPM*								
	Baton	*Ideo*	*Diectic*	*Kineto*	*Ortho*	*Descrip*	*Loca*	*Quant*	*Total*
Experimental									
L1	0.78	0.98	0.59	0.98	0	0.2	0.59	0.39	4.49
L2	2.34	0.64	0.63	0	0	0	0.84	1.47	5.96
L3	2.55	0	0	0	0	0	0.73	0.36	3.64
L4	4.67	0.22	0.07	0	0	0	0.29	0.22	5.47
L5	2.58	1.68	0.13	0.13	0.39	0	0.39	0	5.29
L6	2.98	0	0.85	1.28	0	0.71	1.56	1.84	9.22
L7	4.44	0.65	0.13	1.83	0.26	0.78	2.35	0.78	11.23
L8	4.52	0.55	0.55	0.55	0	0	1.87	0.77	8.81
L9	3.72	0.96	0.72	0.36	0.12	0	0.24	1.32	7.44
L10	3.6	2.32	0.77	0.69	0	0.17	0.51	0.26	8.32
L11	2.18	0.72	0.91	0.36	0.18	0.18	1.64	1.18	6.36
L12	2.29	1.86	0.71	0.57	0.29	0.57	1.71	0.29	8.29
Average GPM	3.05	0.88	0.51	0.56	0.10	0.22	1.06	0.74	
Averaged sum of total GPM									7.04
Control									
C1	2.80	0.00	0.20	0.40	0.00	0.60	1.20	0.20	5.40
C2	2.81	0.00	0.13	0.38	0.00	0.51	0.26	0.00	5.24
C3	0.46	0.22	0.00	0.11	0.46	0.22	0.22	0.22	1.91
C4	0.65	0.26	0.00	0.13	0.13	0.00	0.52	0.00	1.70
C5	2.85	0.10	0.10	0.61	0.31	0.00	0.41	0.20	4.58
C6	1.33	0.78	0.44	1.00	0.22	0.56	1.89	0.33	6.56
C7	2.85	0.19	0.12	0.12	0.06	0.06	0.19	0.25	3.84
C8	6.00	0.26	0.00	0.38	0.00	0.13	0.38	0.26	7.04
Average GPM	2.47	0.23	0.12	0.39	0.15	0.26	0.63	0.18	
Averaged sum of total GPM									4.53

Note. Ideo = ideograph; Kineto = kinetographs; Ortho = orthograph; Descrip = descriptive; Loca = locative; Quant = quantitative.

aphasia differed significantly from the types of gestures that were produced by the neurologically normal control participants. Although there was variation, the experimental participants averaged more GPM than did the control participants. The GPM ratio appeared to increase in accordance with the severity of the participant's aphasia.

Both participant groups produced similar amounts of emphasis gestures. This may indicate that people, regardless of speaking ability, use gestures to enhance conversation and ensure the listener's attention. However, for many persons with aphasia, speech can be limited; therefore, efficient means of communication may come in alternate forms, such as using gestures in a compensatory manner. The participants with aphasia used almost four times the amount of filler gestures and twice the number of content gestures during spontaneous conversation than the neurologically normal participants. This may indicate that the participants with aphasia are using gesture to assist in communicating the intended message.

As for the filler gestures, the abundance of their production by persons with aphasia can be ascribed to the fact that the majority of persons with aphasia have word-finding difficulties and often speech-production deficits, and may use gestures to fill the awkward pauses and moments of silence. The use of filler gestures may also serve to let the listener know that the speaker is not finished and wishes to continue his or her turn in the conversation cycle.

The almost doubled amount of content gestures can also be attributed to the difficulty of speech-production or word-finding deficits that plague many persons with aphasia. If participants cannot retrieve a word or simply cannot produce it verbally, they can use gestures to depict their thoughts as a substitute for the verbal or written word.

LeMay et al. (1988) found similar results in their study, which showed a significant difference in the amounts of batons, ideographs, diectics, and kinetograph type gestures between persons with Broca's and Wernicke's aphasia and neurologically normal control participants. However, no differences were found in the use of pictographs. This current study, in contrast, found no significant difference in the number of batons used by persons with aphasia and control participants. But findings concur with LeMay et al. in the area of ideographs, or fillers. This study also categorized all remaining gestures (diectic, kinetograph, orthograph, and pictograph) into one category, content gestures, unlike the study by LeMay et al., and in doing so found notable differences in the use of these gestures by experimental and control participants. Despite these differences, however, both studies found that illustrative hand gestures are used more by persons with aphasia than by non-aphasic control participants. The implications of these findings show that the use of natural gesture could be enhanced to supplement impaired communication through speech (LeMay et al., 1988).

The major difference between the current study and the one by LeMay et al. (1988) is the inclusion of IMA as a variable. The study by Borod et al. (1989) did include IMA as a variable. The current study, therefore, relates more closely to the Borod et al. study, which examined the relationship between apraxia and the production of gesture

Figure 1. Total gestures per minute by Western Aphasia Battery and Florida Apraxia Battery severity.

Western Aphasia Battery (AQ) \ Florida Apraxia Battery (AxQ)	100	>90	>80	>70	>60	>50	>40	>30	>20	>10	>0
100											
>90		3.6									
>80			5.47					4.5			
>70			5.96 7.44								
>60		8.3	8.29								
>50						8.8			5.29 9.22		
>40				6.4							
>30											
>20							11				
>10											
>0											

in conversation. Although that study did find a significant correlation between praxis ability and spontaneous gestural communication, this study did not.

There did not appear to be a correlation between the GPM ratio with the apraxia scores (Figure 1). In fact, some participants produced gestures correctly during conversation that they were unable to produce at all during the praxis testing. However, during conversation, these gestures were frequently incorrect. The participants with apraxia seemed capable of executing a semblance of the gesture, albeit incorrectly in conversation or with incorrect movements—as though they had attached an incorrect meaning or had difficulty retrieving the correct motor program. Therefore, both retrieval and programming appear to affect the production of gesture by persons with aphasia, and the severity of a person's aphasia is more predictive of his or her gestural abilities than is the severity of his or her IMA.

REFERENCES

Borod, J. C., Fitzpatrick, P. M., Helm-Estabrooks, N., & Goodglass, H. (1989). The relationship between limb apraxia and the spontaneous use of communicative gesture in aphasia. *Brain and Cognition, 10,* 121–131.

Brookshire, R. (2003). *Introduction to neurogenic communication disorders.* Philadelphia: Mosby.

Chapey, R. (2001). *Language intervention strategies in adult aphasia.* Boston: William & Wilkins.

Christopoulou, C., & Bonvillian, J. D. (1985). Sign language, pantomime, and gestural processing in aphasic persons: A review. *Journal of Communication Disorders, 18,* 1–20.

Feyereisen, P., Bouchat, M.-P., Dery, D., & Ruiz, M. (1990). The concomitance of speech and manual gesture in aphasic participants. In E. Hammond (Ed.), *Cerebral control of speech and limb movements* (pp. 15–21). North Holland: Elsevier Science.

Foundas, A. L., Macauley, B. L., Raymer, A. M., Maher, L. M., Heilman, K. M., & Rothi, L. J. (1995). Gesture laterality in aphasic and apraxic stroke patients. *Brain and Cognition, 29,* 204–213.

Glosser, G., Weiner, M., & Kaplan, E. (1986). Communicative gestures in aphasia. *Brain and Language, 27,* 345–359.

Heilman, K. M., & Rothi, L. J. G. (1993). Apraxia. In K. M. Heilman & E. Valenstein (Eds.), *Clinical neuropsychology* (3rd ed., pp. 131–149). New York: Oxford University Press.

Heilman, K. M., & Valenstein, E. (1997). *Clinical neuropsychology* (4th ed.). New York: Oxford University Press.

Kertesz, A. (1982). *Western Aphasia Battery.* New York: Grune and Stratton.

LaPointe, L. (2005). *Aphasia and related neurogenic language disorders.* Boston: Thieme.

LeMay, A., David, R., & Thomas, A. P. (1988). The use of spontaneous gesture by aphasic patients. *Aphasiology, 2,* 137–145.

Macauley, B. L. (1995, April). *Ideomotor apraxia, aphasia, and conversational gesture.* Presentation to the Center for Neuropsychological Studies, University of Florida, Gainesville.

National Aphasia Association. (1999). Aphasia fact sheet. Retrieved May 2, 2003, from http://www.aphasia.org/NAAfactsheet.html

National Stroke Association. (2002). Retrieved April 30, 2002, from http://209.107.44.93/NationalStroke/AboutUs/Giving/default.htm

Pedelty, L. L. (1987). *Gestures in aphasia.* Unpublished doctoral dissertation, University of Chicago.

Raymer, A., & Ochipa, C. (1997). Conceptual praxis. In K. M. Heilman & L. J. G. Rothi (Eds.), *Apraxia* (pp. 51–60). New York: Mosby Press.

Rothi, L. J. (1995, April). *The real world effects of limb apraxia.* Paper presented during a teleconference at the National Center for Neurogenic Communication Disorders, University of Arizona, Tucson.

Rothi, L. J. G., Raymer, A. M., Ochipa, C., Maher, L. M., Greenwald, M. L., & Heilman, K. M. (1992). *Florida Apraxia Battery.* Unpublished document.

Wolf, P. A., Kannel, W. B., & McGee, D. L. (1986). Epidemiology of stroke in North America. In H. J. M. Barnett, B. M. Stein, J. P. Mohr, & F. Yates (Eds.), *Stroke: Pathophysiology, diagnosis, and management* (pp. 19–29). New York: Churchill Livingston.

Contact author: Beth L. Macauley, The University of Alabama, 7 Rowand Johnson Hall, Tuscaloosa, AL 35487-0242. E-mail: bmacaule@bama.ua.edu