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Elicitation of verbs and inflections in nonfluent aphasia

WEIJIA NI*,†,§, DONALD SHANKWEILER*,†,
LAURA CONWAY-PALUMBO†, KATHERINE S. HARRIS*,‡, ROBERT K. FULBRIGHT§,
ROSALIND THORTON#, AND STEPHEN CRAIN#

**Haskins Laboratories, †University of Connecticut,*
‡City University of New York Graduate Center,
#University of Maryland, and §Yale University School of Medicine

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Send correspondence to:

Weijia Ni Haskins Laboratories 270 Crown St. New Haven, CT 06511 weijia.ni@yale.edu	or	Donald Shankweiler Dept of Psychology University of Connecticut Storrs, CT 06269 dshank@uconnvm.uconn.edu

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INTRODUCTION

The distinction between structural deficit and processing limitation is a central theme in contemporary studies of agrammatism. Are the difficulties in agrammatism caused by deformed or missing morphosyntactic structures? Alternatively, do aphasics' processing difficulties limit their access to the variety of morphological forms and sentence constructions and lead to lack of well-formedness of the constructions that are produced? At all events, linguistic theory directs us to expect connections between difficulties in production of verbs and their parts and difficulties in production of sentences (LaPointe, 1985).

Most word retrieval studies in aphasia have been about noun-finding, not about verb-finding, yet it is evident that many aphasics show reductions in verb form use (Goodglass, 1993). This is attested by Goodglass, Christiansen and Gallagher (1993) who studied the abilities of agrammatic aphasics to produce morphological elements in sentence frames. Nouns were more often elicited than verbs and function words, and past-tense verb forms were especially difficult (See also Berndt, Mitchum, Haendiges & Sandson, 1997; Meth, Obler, Harris & Schwartz, 1995).

Evidence that the variety of verb forms may be severely reduced in agrammatism was presented by Miceli, Silveri, Villa, and Caramazza (1984). These authors make the further claim that dissociable deficits in stem retrieval and tense markers may be found in different groups of aphasics. Yet the relation between verb retrieval and inflection has rarely been studied, as Bastiaanse, Jonkers, Quak, and Put (1996) recently note. We know of no such studies in English.

Our goal was to carry out a coordinated study of verb production and past tense inflections in aphasics who vary in fluency and who present with agrammatic or paragrammatic symptomatology.

In past work, the study of verb retrieval has relied chiefly on three methods. All have serious inadequacies:

1. **Repetition** -- Arbitrary; lacks social context.
2. **Picture (action) naming** -- Picture parsing introduces linguistically irrelevant demands.
3. **Speech corpus** -- Analysis leads to underestimate of competence -- difficult forms avoided.

To test the limits of verb production capability in aphasics, we adopted the **Elicited Production** procedure, which has been used successfully in language acquisition research to reveal children's grammatical knowledge inaccessible to other methods of study (Crain and Thornton, 1998).

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METHOD

Subjects:

Four well-stabilized aphasic individuals were tested. They ranged in severity from extremely nonfluent, with chiefly one- or two-word utterances, to moderate limitation of utterance length and syntactic variety. In the following table, the patients are arranged from left to right in order of increasing severity.

	MK	HO	HW	JN
Age	58	69	62	73
Gender	Female	Female	Male	Female
Education	Colledge graduate	High School	High School	Colledge graduate
Years post-onset	4	4	5	6
BDAE %ile score	95	89	70	60.5
Phrase Length	(data missing)	3.25 words	3.25 words	1.25 words

Materials:

Twelve past tense verbs were paired with homophonic nouns and adjectives. Materials included regular and irregular verbs, derived and underived adjectives, and singular nouns.

e.g., **towed / toad** (verb - noun)
blew / blue (verb - adjective)

Procedure:

The elicitation task entails sentence completion with supporting contexts. The participant supplies a response to complete the detail of a story vignette. There are three components:

1. A visual context: Story vignettes acted out with toy props.
2. An auditory context: Supplements actions; conveys intentions and relationships among characters in the story.
3. An elicitation prompt: Subject produces target while recounting a detail of the story.

For this specific experiment where we elicit past tense verbs, the visual and auditory components of the eliciting context emphasize completed actions. These pragmatic details provide a felicitous environment for the production of past tense morphology without the need for modeling. There were 24 story vignettes, each eliciting either a past tense verb or a noun or adjective. They were quasi-randomized so that the homophonic pairs did not immediately follow one another.

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DISCUSSION

The elicited production method was successful in eliciting some verb stems (and their homophonic noun/adjective counterparts) from even the most severely agrammatic subject. Correct past tense inflections were elicited from 3 of the 4 aphasic subjects, including one (HM) with marked agrammatism. Two normal subjects showed 100% retrieval of targeted stems and inflections.

The results for HW and JN show that stems and inflections can be dissociated by a brain lesion, as Miceli et al. (1984) found in studies with Italian aphasics. This has implications for the structure of the language system, supporting other indications that the lexicon has a specific architecture where verbs are stored in parts (see Caramazza & Hills, 1991).

All four subjects showed extensive damage to frontal (premotor) regions (not in every case implicating Broca's area, however), with parietal involvement in three out of four. In two of the subjects, HW and JN, the temporal lobe was implicated (in middle and superior temporal gyri). This lesion seemed critical for verbal inflections, in that the two subjects who reliably produced past-tense forms (MK and HO) showed sparing of these regions. It is of interest, in this connection, that severe agrammatism (manifested by HW and JN) was associated with a very large lesion not confined to anterior regions (see Mohr, 1979).

The aphasic pattern in HW and JN resembles that attributed to young children proceeding through the **Optional Infinitive Stage** (OI) of normal language acquisition (Wexler, 1996). During the Optional Infinitive Stage, between age 2.0 and 2.5, the bare stems may optionally be used where the inflected forms are required, as for -s and -ed markings on verbs. The account of OI proposed by Wexler and others assumes a structural limitation in young children's grammars. An alternative account of the OI phenomenon that appeals to children's processing limitations has been given by Philip (1995).

Can the findings obtained with HW and JN be related to the OI stage in language development? Both populations appear to have the knowledge of verb stems and inflections, but they sometimes fail to merge the two elements. The two phenomena can be given a unified account if a limitation on working memory processing is assumed to be the cause of omissions of inflections in both children and adult aphasics. In that case, we would expect that children and aphasics in languages other than English would, on occasion, produce the default rather than the correctly inflected form. (See Grodzinsky, 1982, for discussion of agrammatism in speakers of a heavily inflected language.)

A processing limitation account of agrammatic aphasia is supported by proposals by Linebargar, Schwartz and Saffran (1983) and Shankweiler, Crain, Gorrell and Tuller (1989) based on evidence on the receptive side. Agrammatics generally retain the ability to perform grammaticality judgments and to carry out real-time sentence processing operations. An earlier study of the production of relative clause sentences by these same subjects (Ni, Shankweiler, Harris, & Fulbright, 1997) also supports the view that aphasic individuals may fail to reliably access the appropriate syntactic structures, but the structures are retained.

Summary comments on use of an elicited production method for study of verb morphology in aphasia:

1. By creating appropriate contexts and eliminating the need for modeling, we elicited verbs and past-tense inflections that rarely occur spontaneously in agrammatic aphasia.
2. The real-time presentation poses minimal interpretive demands on the subject by placing objects, properties and events on equal ground. It reduces bias against verbs, a bias that has been implicated in picture-naming tasks.
3. The presentation emphasizes completed action, which makes production of the past tense forms felicitous.
4. The conversational dynamic simulates the conditions of ordinary language use, motivating the subject's contribution and supporting ordinary pragmatic expectations.
5. By using homophones that differ in word class (verb vs. noun or adjective) but pose the same requirements in phonetic production (e.g., **towed/toad**), retrieval differences across word classes can be given an unequivocal interpretation.
6. The elicitation of past tense verb forms enables us to further distinguish difficulties in retrieval of the stem and retrieval of an associated grammatical morpheme (the tense marker).

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APPENDIX: BRAIN IMAGING STUDIES (MRI)

MK

Infarct resulted in encephalomalacia, gliosis or both in aspects of the inferior frontal gyrus (BA44, 45); lateral orbital gyrus (BA47, 11); middle frontal gyrus (BA9, 10, 46); precentral gyrus (BA6, 4); postcentral gyrus (BA3, 1); supramarginal gyrus (BA40); angular gyrus (BA39); small portion of the posterior superior temporal gyrus (BA22); insula; subinsular regions; superior longitudiani fasiculus; and the occipital frontal fasiculus.

HW

Infarct (encephalomalacia, gliosis, or both) involves pars opercula and pars triangularis of the inferior frontal gyrus (BA 44, 45); precentral gyrus (BA4, 6); postcentral gyrus (BA3, 1); supramarginal gyrus (BA40); angular gyrus (BA39); posterior aspect of superior temporal gyrus (BA22); insula; subinsula regions; posterior limb of internal capsule and corona radiata.

HO

schemic damage largely in the form of encephalomalacia involves precentral gyrus (BA6, 4); postcentral gyrus (BA3, 1); insula, posterior limb of internal capsule; and middle and posterior corona radiata. Broca's area is spared.

JN

Ischemic insult damaged inferior frontal gyrus (BA44, 45); precentral gyrus (BA6, 4); postcentral gyrus (BA3, 1); middle frontal gyrus (BA9, 46); supramarginal gyrus (BA40); angular gyrus (BA39); superior temporal gyrus (BA52, 41, 42, 22); middle temporal gyrus (BA21, 37); insula; subinsula regions; anterior and posterior limbs of the internal capsule; anterior and posterior limbs of the corona radiata; superior longitudinal fasiculus; occipital frontal fasiculus.

	MK			HO			HW			JN	
[illegible]	[illegible]	[illegible]									[illegible]
Cortex											
Inferior frontal gyrus, pars opercula (BA 44)	1	1		0	0		1	1		1	1
Inferior frontal gyrus, pars triangularis (BA 45)	1	1		0	0		1	1		1	1
Lateral orbital gyrus (BA 47, 11)	1	1		0	0		0	0		1	1
Posterior orbital gyrus (BA 11, 12)	0	0		0	0		0	0		1	1
Precentral gyrus, anterior-inferior aspect (BA 6)	1	1		1	1		1	1		1	1
Precentral gyrus, anterior-superior aspect (BA 6)	0	1		1	1		1	1		1	1
Precentral gyrus, posterior aspect (BA 4)	0	1		1	1		1	1		1	1
Postcentral gyrus, anterior aspect (BA 3,1)	0	1		0	0		1	1		1	1
Superior frontal gyrus, posterior and medial aspect (BA 6)	0	0		1	1		1	1		0	0
Middle frontal gyrus, (BA 6, 9, 46,10)	0	1		0	0		1	1		1	1
Superior temporal gyrus, posterior aspect (BA 22)	0	1		0	0		1	1		1	1
Superior temporal gyrus, middle aspect (BA 41,42)	0	0		0	0		1	1		1	1
Superior temporal gyrus,anterior aspect (BA 52, 22)	0	0		0	0		0	0		1	1
Middle temporal gyrus (BA 21, 37)	0	0		0	0		0	0		1	1
Inferior temporal gyrus (BA 20, 37)	0	0		0	0		0	0		1	1
Supramarginal gyrus, (BA 40)	0	1		0	0		1	1		1	1
Angular gyrus, (BA 39)	0	1		0	0		1	1		1	1
Insula	1	1		1	1		1	0		1	1
Inferior occipital gyrus (BA 18, 19)	0	0		0	0		0	0		1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Subcortical											
Subinsular regions (extreme capsule and claustrum, external capsule)	0	1		0	0		0	1		0	1
Putamen	0	0		0	0		0	1		0	0
Internal capsule genu	0	0		0	0		0	1		0	0
Internal capsule anterior limb	0	0		0	0		0	0		0	1
Internal capsule posterior limb	0	0		0	1		0	0		0	1
Corona radiata anterior	0	0		0	0		0	1		0	1
Corona radiata middle	0	0		0	1		0	1		0	0
Corona radiata posterior	0	0		0	1		0	0		0	1
Superior longitudinal fasiculus	0	1		0	1		0	1		0	1
Occipital frontal fasiculus (medial subcallosal fasiculus)	0	0		0	1		0	0		0	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Each region is in left hemisphere; E = encephalomalacia, G = gliosis; 1 = infarct, 0 = no infarct