In non-fluent aphasias, oral expression is typically fragmented, and lacking in grammatical completeness and complexity, known as agrammatism. By contrast, in fluent aphasias, oral expression is generally described as being grammatical, albeit with frequent lexical substitutions which disrupt the messsage's content. Despite this persistent impression, it has long been recognized that grammaticality in fluent aphasia is not entirely preserved. Although the overall pattern of speech is distinctly different from non-fluent aphasia, errors of sentence structure and inflectional morphology do occur. This has been called 'paragrammatism' (Kleist, 1916).

Butterworth and Howard (1987) differentiated paragrammatism from agrammatism, in that paragrammatism involves confused and erroneous syntax rather than reductions in grammatical structure. These authors investigated the grammatical performance of five individuals with fluent paragrammatic aphasia. They outlined four hypotheses potentially accounting for the underlying deficit in paragrammatism: 1) an underlying syntactic disturbance; 2) an underlying deficit in word selection; 3) a monitoring failure; and 4) an underlying 'control impairment', in which paragrammatic errors are similar to normal errors, but are produced more frequently as a result of a general cognitive overload. Since then, only a handful of studies have investigated paragrammatism systematically, and the underlying deficit remains poorly understood.

In the current study, we compared the lexical and grammatical abilities of an individual with paragrammatism and an individual with agrammatism, by eliciting output in structured tasks (naming and sentence production) and spontaneous speech tasks. Our goal was to determine whether paragrammatism could be attributed to syntactic or lexical retrieval deficits alone, to a combination of the two, and/or to some additional, more global, processing factor.

Participants

Participant PG. Our participant with paragrammatism, whom we call PG, was a 69-year-old woman at the time of the study, who underwent clipping of bilateral MCA aneurysms nine years earlier. According to the Western Aphasia Battery (Kertesz, 1982), she was diagnosed with moderate-to-severe Wernicke's aphasia (AQ=32/100), characterized by a severe auditory comprehension impairment and moderate-to-severe oral expressive deficits. Her reading comprehension was also impaired, but a relative strength. PG's spontaneous speech was fluent, often hyper-fluent, but with significant word retrieval difficulties.

Participant AG. Our participant with agrammatism, called AG, was a 46-year-old man at the time of the study, who had suffered a traumatic brain injury 10 years earlier. His diagnosis was moderate Broca's aphasia with apraxia (AQ=57/100). AG's spontaneous speech was characterized by word-finding difficulty and agrammatic behaviors (e.g. omission of inflectional markers and function words; simplified grammatical structure).

Procedures

Participants were asked to produce speech in different contexts varying in their linguistic demands. Spontaneous speech samples were elicited using three different tasks: description of ten Norman Rockwell pictures; retelling of the Cinderella story; and three personal narratives. Speech samples were analyzed using the Quantitative Production Analysis (QPA, Berndt, Wayland, Rochon, Saffran & Schwartz, 2000).

Participants also named pictures of nouns and verbs, to allow us to examine their lexical retrieval abilities without making demands on grammatical abilities. Participants were shown drawings of 30 verbs from the *Northwestern University Verb Production Battery* (Thompson, unpublished). Thirty nouns from the same pictures were also named, in a separate task. Nouns and verbs were chosen as targets for naming because dissociations between these two word classes have been reported in different types of aphasia (e.g. Kim & Thompson, 2000). Responses were scored for accuracy, and categorized by error type.

The pictures used in the naming subtests were also used to assess grammaticality of sentence production. In this task, labels for the target nouns and uninflected verbs were printed on the pictures to minimize word-retrieval demands, and participants were asked to produce a sentence about the picture using all of the words provided. Sentences in this task varied in complexity by including verbs taking one, two, or three arguments. Responses were scored for grammaticality, the number of targets produced and used in their correct roles (as subject, main verb, direct object, and indirect object), and inflection of the target verb.

Results

Results of the QPA analysis are presented in Table 1. Our participants' performance on the QPA measures was compared to similar data from subjects in previous studies: two subjects with Wernicke's aphasia (Bird & Franklin, 1996); five with non-fluent agrammatic aphasia and five with non-fluent non-agrammatic aphasia (Saffran, Berndt, & Schwartz, 1989); and 22 non-brain damaged (NBD) subjects (compiled from Bird & Franklin, 1996; Saffran et al., 1989; and Rochon, Saffran, Berndt, & Schwartz, 2000). Scores which are two standard deviations below the mean of the NBD group are indicated with an asterisk.

Both PG and AG showed significant reductions in spontaneous speech measures relative to NBD subjects. AG performed in a manner typical of other agrammatic speakers, except with regard to his noun:pronoun and noun:verb ratios. On the other hand, PG performed more like agrammatic speakers than either NBD speakers or other subjects with Wernicke's aphasia, particularly on structural measures reflecting sentence grammaticality and function word usage. It is particularly notable that PG showed significantly reduced verb inflection, a measure which cannot be attributed to word retrieval difficulties.

In picture naming, both PG and AG showed better noun naming than verb naming, a typical agrammatic pattern (see Figure 1 below). Their error patterns differed, however, suggesting different underlying sources of the errors. In particular, PG made more overt errors in both tasks, whereas many of AG's 'Other' errors were phonemic attempts without a completed response. This likely represents AG's greater awareness of his errors. On the other hand, PG made more 'Unrelated' errors, especially in naming verbs. Many of these consisted of so-called 'light' verbs, such as *be, go*, and *make*. For example, instead of producing the target *jumping*, PG described this action as "going over the fence".

In the sentence production task, both subjects were able to produce the majority of target words (recall, they were written on the pictures), but had difficulty producing them in their correct syntactic roles and, as a result, produced few grammatical sentences. AG had particular difficulty producing target nouns as subjects; he almost invariably inserted a pronoun as the verb's subject. His use of the target verbs was relatively good, although it did decrease in more complex sentence types. By contrast, PG showed similar difficulty with all sentence components,

and did not show a sentence complexity effect. Her sentences were characterized by an over-reliance on light verbs and prepositional phrases, e.g. *The boy watches TV* was produced as "The boy has a watch on the TV."

Discussion

Results suggest that paragrammatism in spontaneous speech arises from a combination of lexical retrieval and syntactic deficits, but that other strategic factors likely contribute as well. Both PG and AG showed significant lexical retrieval difficulties, verbs being more difficult than nouns. However, these alone could not account for PG's spontaneous speech difficulties, as she demonstrated worse naming performance than AG, but better performance on the spontaneous speech measures. In addition, grammatical deficits were clearly evident for both participants in the sentence production task, even though word retrieval demands were minimized. Despite these similarities, expressive patterns were distinct in the two participants, suggesting that they adopted different strategies to attempt to cope with their lexical retrieval and grammatical impairments (Kolk & Heeschen, 1992).

References

Berndt, R.S., Wayland, S., Rochon, E., Saffran, E., & Schwartz, M. (2000). *Quantitative production analysis: A training manual for the analysis of aphasic sentence production.* Hove, UK: Psychology Press.

Bird, H., & Franklin, S. (1995/6). Cinderella revisited: A comparison of fluent and non-fluent aphasic speech. *Journal of Neurolinguistics*, 9(3), 187-206.

Butterworth, B., & Howard, D. (1987). Paragrammatisms. *Cognition*, 26(1), 1-37.

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

Kim, M., & Thompson, C.K. (2000). Patterns of comprehension and production of nouns and verbs in agrammatism: Implications for lexical organization. *Brain and Language*, 74, 1-25.

Kleist, K. (1916). Uber Leitungsaphasie und grammatische Storungen. *Zeitschrift fur Psychiatrie und Neurologie*, 40, 118-199.

Kolk, H., & Heeschen, C. (1992). Agrammatism, paragrammatism and the management of language. *Language and Cognitive Processes*, 7(2), 89-129.

Rochon, E., Saffran, E.M., Berndt, R.S., & Schwartz, M.F. (2000). Quantitative analysis of aphasic sentence production: Further development and new data. *Brain and Language*, 72, 193-218.

Saffran, E.M., Berndt, R.S., & Schwartz, M.F. (1989). The quantitative analysis of agrammatic production: Procedure and data. *Brain and Language*, 37, 440-479.

Thompson, C.K. (unpublished). *Northwestern University Verb Production Battery*.

Table 1. QPA measures of PG and AG, compared to subjects from previous studies with no brain damage (NBD), Wernicke's aphasia (Wern.), or non-fluent aphasia with agrammatism (Agram.) or without agrammatism (Non-Agram.).

Spontaneous Speech Measures	NBD (n=22)	NBD St.Dev.	PG	Wern. (n=2)	AG	Agram. (n=5)	Non-Agram. (n=5)
Discourse Measures							
Speech Rate (wpm)	147.54	32.71	109.60	124.00	80.9 *	31.4 *	44.6 *
% Narrative Words	0.84	0.07	0.64 *	*NA*	0.58 *	*NA*	*NA*
Narrative WPM	123.90	*NA*	70.10	*NA*	46.80	*NA*	*NA*
Productivity Measures							
Sentence Length	11.41	3.19	5.71	9.20	4.32 *	4.02 *	6.48
Elaboration Index	3.28	2.72	1.58	2.23	1.14	1.07	1.88
Embedding Index	0.37	0.22	0.08	0.38	0.07	0.03	0.15
Structural Measures							
% Words in Sentences	0.99	0.04	0.82 *	0.97	0.73 *	0.43 *	0.93
% Sentences Well-Formed	0.95	0.06	0.72 *	0.74	0.35 *	0.33 *	0.74 *
Inflection Index	0.95	0.11	0.49 *	0.96	0.07 *	0.34 *	0.77
Auxiliary Complexity	1.30	0.23	0.72 *	1.41	0.28 *	0.51 *	1.16
Lexical Measures							
% Closed Class Words	0.55	0.03	0.58	0.59	0.49	0.33 *	0.51
Determiner Index	0.99	0.01	0.94 *	1.00	0.44 *	0.37 *	0.92 *
Noun:Pronoun Ratio	1.65	0.62	1.00	1.46	1.08	8.93 **	1.70
Noun:Verb Ratio	1.16	0.25	0.99	0.70	0.98	2.93 **	1.15

* 2 standard deviations below the mean of NBD subjects
** 2 standard deviation above the mean of NBD subjects

Table 2. Sentence production scores for PG and AG, according to sentence type.

	Sentence Type			
Measure	S-V (n=10)	S-V-O (n=18)	S-V-O-IO (n=10)	Overall
PG				
% Targets Present	1.00	0.96	0.90	0.95
% Targets Correct	0.15	0.30	0.23	0.25
% Grammatical	0.30	0.06	0.10	0.13
% Target Vbs Inflected	0.10	0.06	0.00	0.06
AG				
% Targets Present	0.80	0.72	0.73	0.74
% Targets Correct	0.50	0.28	0.45	0.38
% Grammatical	0.00	0.00	0.00	0.00
% Target Vbs Inflected	0.00	0.11	0.20	0.12

S = subject; V = verb; O = direct object; IO = indirect object

Figure 1. Noun and verb naming responses for PG and AG.