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To make a long story short: A descriptive study of formulaic language use in post-stroke fluent aphasia

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ABSTRACT

Background: Language sample analysis is a common tool for inventorying an individual's linguistic strengths and weaknesses. Although most research has focused on quantifying propositional or novel language production, studies suggest that individuals with aphasia, specifically nonfluent aphasia, produce high percentages of formulaic language relative to healthy controls. To date, little is known about how individuals with fluent aphasia subtypes use formulaic language and how the elicitation task influences their production.

Aims: The purpose of this research was to comprehensively describe patterns of formulaic language use in various discourse tasks in language samples of individuals with fluent aphasia.

Methods & Procedures: The retrospective analysis included discourse samples from Aphasiabank from 142 individuals with anomic, conduction, and Wernicke's aphasia across four monologic discourse tasks. After identifying and classifying formulaic items into nine types, percentages of formulaic language were calculated for each participant and discourse task. Non-parametric statistics and Pearson's correlations were used to compare production patterns and explore relationships between language severity and formulaic item types.

Outcomes & Results: Unique patterns of formulaic language were observed across groups including lower proportions of fillers in individuals with Wernicke's aphasia and higher proportions of yes/no variants and speech formulas in individuals with conduction aphasia. Production patterns were most influenced by discourse task in individuals with anomic aphasia. Formulaic language use did not correlate with aphasia severity as measured by aphasia quotient.

Conclusions: Findings add to the evidence base describing formulaic language usage in individuals with post-stroke aphasia, which serves as a necessary foundation for eventual clinical application.

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Introduction

Spontaneous language samples are commonly collected from individuals with aphasia during speech-language pathology assessment and treatment (Bryant, et al., 2017). There are a variety of empirically-based analyses for describing an individual's expressive language skills during discourse production (Coehlo et al., 2023). From a functional

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perspective, discourse sampling can potentially enable the clinician to inventory linguistic items and structures that an individual has at his or her disposal for communication, although language genre and task have been shown to influence these conclusions (Armstrong et al., 2011; Leaman & Archer, 2023).

One type of linguistic item that can be readily analysed from language samples of people with aphasia (PWA) is formulaic language (also referred to as familiar or non-propositional language; e.g., *it's all good, yes please, some sort of . . .*). Formulaic language differs from novel, or propositional, language because it is stored and retrieved as recognizable, stereotyped utterances (Van Lancker Sidtis, 2020; Wray, 2017). It also substantively differs from automatic speech or automatisms such as those observed in some individuals with severe expressive impairments who verbally communicate using a limited set of lexical or non-lexical sequences (Code et al., 2009). Van Lancker Sidtis (2004) argues that formulaic language has five distinct properties: stereotyped form (or cohesion), conventionalized meaning, association with social context, inclusion of attitudinal and affective valence, and familiarity/recognition by native speakers. Propositional language, by contrast, is governed by grammatical rules that allows speakers to create novel combinations of linguistic items for language expression (Van Lancker Sidtis, 2020). Importantly, the concept of propositionality is not synonymous with meaning or intention but rather familiarity of the linguistic form (e.g., "Hi, how are you doing?" versus "What a pleasant event it is to see you. Tell me, how is your life progressing at the moment?"; Wray, 2002, p. 12).

A number of studies have indicated that PWA rely more heavily on formulaic language to communicate than healthy speakers who are not limited in their propositional language abilities (Torrington Eaton & Burrowes, 2021; Van Lancker Sidtis & Yang, 2017; Zimmerer et al., 2018). This finding supports the dual-process model of language described by Van Lancker Sidtis (2020). In this model, distinct neural networks underlie propositional versus non-propositional language production (left inferior frontal versus right frontal and subcortical regions, respectively; Sidtis et al., 2018). It follows logically that individuals presenting with Broca's aphasia, who have damage to the left inferior frontal cortex, would produce higher proportions of language that is generated in spared neural regions. Evidence has shown that these individuals do, in fact, produce high proportions of formulaic language especially as compared to healthy individuals (Torrington Eaton & Burrowes, 2021).

What is not known, however, is whether individuals with other subtypes of aphasia, in which the left inferior frontal region is not affected, produce similar proportions and patterns of formulaic language. Most studies that have compared formulaic language production in PWA and healthy speakers have included a variety of aphasia subtypes in the clinical group (e.g., Van Lancker Sidtis et al., 2004; Van Lancker Sidtis & Yang, 2017), thus obscuring within-group differences. Because of the proposed benefit of decreasing cognitive burden through retrieval of familiar, pre-packaged items (Conklin & Schmitt, 2012; Wray, 2017), it seems likely that individuals with aphasia, regardless of subtype, would make use of formulaic language when communicating.

Proportion, or quantity, of formulaic language production across aphasia subtypes is not the only consideration. Formulaic language is not one entity; rather, there are diverse types that vary along a continuum according to the following linguistic characteristics: cohesiveness, nuance, frequency, literality, dependence on context, and construction type

(Van Lancker Sidtis, 2020). For example, speech formulas (e.g., *I gotta go, You got this?*) are fairly cohesive, syntactically complete items with strong nuance that serve a pragmatic function in prescribed contexts. By contrast, lexical bundles (e.g., *I believe . . ., in order to*) and formulaic sequences (e.g., *later that day, by the way*) are highly cohesive (invariant) and embedded in propositional utterances, neutral in connotation, and useful in organizing discourse and qualifying the speaker's intention. Idioms (e.g., *bite the bullet, break a leg*), which are non-literal, cohesive, and low frequency, are rich in nuance. Applied to aphasia, it is not unreasonable to presume that the linguistic characteristics, which are inherent in different item types, influence formulaic language production in PWA based on the nature of individuals' linguistic strengths and weaknesses.

A study by Torrington Eaton and Burrowes (2021) provided a formulaic language profile of individuals with Broca's aphasia. Results from a dataset of language samples from 77 individuals demonstrated a reliance on formulaic item types that are syntactically complete and pre-packaged for pragmatic use: interjectional phrases (e.g., *Oh my!*), greetings and farewells (e.g., *Have a nice day!*) and speech formulas (e.g., *Why not?*). Results also showed high percentages of phatic interjections (i.e., variants of yes/no questions such as *absolutely* and *nope*), and fillers (e.g., *um, I mean*). Productions of higher frequency, context-independent items with little to no nuance- lexical bundles (e.g., *as much as*) and formulaic sequences (e.g., *and suddenly*)- did not significantly differ between the aphasia and healthy control groups. Importantly, this study provided a basis for comparing formulaic language profiles across other subtypes of aphasia.

Elicitation task in spontaneous speech

As introduced, spontaneous language samples are often used to provide clinically-relevant information about an individual's linguistic abilities within a pseudo-naturalistic context (i.e., in a clinical space, but without the constraints of formalized assessments). The content of language collected, however, varies widely based on how spontaneous speech is elicited. Researchers have described differential effects based on discourse task or genre (e.g., picture description, conversational interaction, narrative discourse) on both lexical and grammatical content (Bryant, et al., 2016; Leaman & Archer, 2023; Leaman & Edmonds, 2023; Stark, 2019). Work by Dipper and colleagues (2018), for example, found that discourse genre affected both structural and lexical complexity in PWA. Leaman and Archer (2023) provided evidence of linguistic differences on individuals' conversational versus monologic discourse. Even topic of discourse has been shown to significantly affect linguistic performance (Chin Li et al., 1995; Williams et al., 1994). Notably, the majority of these studies do not distinguish effects of discourse type and topic according to aphasia subtype.

Though most research on discourse in PWA has analysed conventional language measures, in their retrospective study of individuals with Broca's aphasia, Torrington Eaton and Burrowes (2021) examined non-propositional language usage across monologic discourse tasks elicited using the Aphasiabank testing protocol. Findings indicated that participants' production was heavily influenced by both discourse task and topic; the percentage of formulaic language usage from least to greatest was the Cinderella narrative (i.e., "Tell me as much of the story of Cinderella as you can."), Stroke recount (i.e., "Do you remember when you had your stroke? Please tell me about it."), Important event recount (i.e., "Thinking back, can you tell me a story about something important that happened in your life?"), and Speech status recount (i.e., "How do you think your speech is these days?"). Furthermore, the types of formulaic language produced also differed by discourse task and topic. For example, lower percentages of lexical bundles and speech formulas were used in the Cinderella narrative when compared to Stroke and Important event recounts. Interestingly, similar usage patterns across discourse tasks were observed in healthy controls, although their overall percentage of formulaic language was lower and far less variable than in the group with aphasia.

In sum, evidence indicates that for many individuals with aphasia, both propositional and non-propositional language production is affected by how discourse is elicited (Leaman & Edmonds, 2023; Torrington Eaton & Burrowes, 2021). Comprehensive descriptions of formulaic language use according to aphasia subtype (i.e., linguistic profile) should consider the effects of discourse task.

Research questions and hypotheses

Language sample analysis is a clinical tool for baselining and documenting changes in an individual's expressive language abilities at least within the confines of a specific discourse type (Leaman & Archer, 2023). An inventory of non-propositional language usage across various discourse tasks is a useful addition for describing functional language and potentially capitalizing on spared language in discourse intervention. Before advances can be made for clinical use, foundational work should describe formulaic language profiles across subtypes of aphasia including effects based on discourse task. This retrospective study using language samples from Aphasiabank aimed to examine patterns of formulaic language use across four monologic discourse tasks from PWA with fluent aphasia subtypes. Specifically, we examined the following research questions and hypotheses respectively:

RQ1: Does formulaic language use differ across three types of fluent aphasia: anomic, conduction, and Wernicke's? Because of similarities in linguistic profiles, we hypothesized that individuals with anomic and conduction aphasias would produce similar patterns of formulaic language use in spontaneous speech as compared to individuals with Wernicke's aphasia.

RQ2: Does formulaic language usage in PWA with fluent aphasias differ across discourse tasks? Based on findings from a similar study of individuals with Broca's aphasia, we hypothesized that total formulaic language production as well as usage patterns would differ according to the task and/or topic used to elicit monologic discourse.

RQ3: What is the relationship between language task performance and percentage of formulaic language use in individuals with fluent aphasia? We hypothesized a positive correlation between aphasia severity and formulaic language use, as found in individuals with Broca's aphasia.

RQ4: How do observed formulaic language usage patterns for fluent aphasias compare to findings in Broca's aphasia? We hypothesized distinct patterns in fluent aphasia subtypes as compared to Broca's aphasia based on differences in linguistic profiles.

Methods

Participants

Participant data were from the online repository Aphasiabank (MacWhinney et al., 2011), and consisted of demographic information, standardized assessment scores, and spontaneous language transcripts. One hundred forty-two individuals were selected based on a clinical diagnosis of fluent aphasia from the Western Aphasia Battery-Revised (WAB-R; Kertesz, 2007). Individuals with anomic aphasia were age- and gender-matched with participants with the original Broca's aphasia dataset (Torrington Eaton & Burrows, 2021), yielding 77 participants. For individuals with conduction and Wernicke's aphasias, all data available in October, 2021 were included, which consisted of 43 and 22 participants respectively.

Procedures

Procedures were based on those described in Torrington Eaton and Burrowes (2021) in order to directly compare findings. Master's level graduate students in speech-language pathology were trained to identify formulaic language by participating in three hours of hands-on instruction to recognize and classify formulaic language types. After the training, research assistants (RAs) were required to demonstrate competency as defined by greater than 80% inter-rater reliability with the first author on at least one transcript from TBIbank.

For each participant, spontaneous language transcripts were downloaded and then divided into four language samples (Cinderella narrative discourse and three recount discourse topics: Stroke story, Important event, and current Speech status). Trained RAs reviewed each transcript and listed formulaic language items produced by the participant to a consolidated spreadsheet. After the initial manual search was complete, two RAs (the second author and one additional RA) were tasked with classifying the identified formulaic language items into one or more categories [e.g., *I know* is a speech formula when used as a stand-alone response ("I know.") or a lexical bundle when used as a sentence frame ("I know that … ")]. The nine formulaic language categories included: pause fillers (five total word and nonword items, i.e., *um, uh, I mean, you know, like*), interjectional phrases (reactionary cries, e.g., *What the heck?!, Boy oh boy*!), vocatives (turn-taking markers at the beginning of utterances, e.g., *so anyway, basically*, …), phatic interjections (variants of yes/no in response to an explicit question, e.g., *Nah. Yes please*.), greetings and farewells (e.g., *nice to meet you, take it easy*), speech formulas (grammatically complete, functional utterances, e.g., *Wait a minute. I have no idea*.), idioms and proverbs (e.g., *it fits like a glove, gotta keep on going*), formulaic sequences (fixed and complete phrases with neutral meanings, e.g., *and suddenly, stuff like that*), and lexical bundles (incomplete phrases that bridge or begin utterances e.g., *it became clear that* …, *as much as*).

Commands from Computerized Language Analysis Software (CLAN; MacWhinney, 2000) were used to search all formulaic items across transcripts. Spreadsheets of formulaic language items by participant, discourse task, and formulaic language type were then collated. As a final step, the first and second authors verified items in each spreadsheet, which required making classification decisions according to the surrounding language context. Specifically, duplicate entries were deleted when a formulaic item was included in more than one category (e.g., *come on* was counted as either a speech formula or an interjection depending on surrounding context). Additional items that did not meet the criterion for a formulaic language category because of surrounding language context were also deleted (e.g., a yes/no variant was used for interactional/turn-taking purposes rather than in response to a question).

Reliability

As mentioned, the second author and one RA independently classified all identified formulaic language items. Of 850 items, the raters were in complete agreement on 93.8% of classifications ($r < .001$, $p = .998$). A consensus process, which included the first author, was used to resolve disagreements in category assignments. Of the 112 items for which there were disagreements, 63 were resolved by including formulaic items into more than one category based on the surrounding language context, 22 were resolved by verifying whether the item met frequency criteria to be classified as an idiom (i.e.,<100 - per million, Nekrasova, 2009), and 27 were resolved through discussion.

Statistical analyses

For each participant, proportions of formulaic language were calculated for each category by dividing the number of items produced (i.e., tokens) by the total number of words in the sample. These calculations were made for each of the four discourse tasks as well as for the entire language sample. Because of the over-representation of non-word fillers (*uh, um*) that occurred during word-retrieval difficulties, these tokens were excluded from the dividend (total number of words) for all but one analysis, proportion of fillers.

One-way analyses of variance and Chi-square tests were used to compare demographic characteristics across fluent aphasia subtypes. Because data from five of the nine formulaic language categories and one discourse task failed to meet assumptions of homogeneity of variance, nonparametric analyses were determined as most appropriate. Kruskall-Wallis tests were used to compare formulaic use across subtypes of fluent aphasia and Friedmann's tests were used to analyse within-group differences across the four discourse tasks. Dunn's tests adjusted by Bonferroni correction were used to examine pairwise comparisons.

Results

Participant characteristics

Analyses were run to examine differences in demographic factors and WAB-R scores across aphasia groups. There were no statistically significant differences between the three aphasia subtypes in gender, $\chi^2(2) = 0.830$, $p = 0.660$; race, $\chi^2(8) = 7.802$, $p = 0.453$; level of education, $F(2, 132) = 0.383$; $p = 0.116$; or age, $F(2, 138) = 1.369$, $p = 0.258$. The majority of participants across subtypes were in their 60s, male, and caucasian with a college degree. There was a statistically significant between-group difference in WAB-

R aphasia quotient (WAB-R AQ), $F(2, 138) = 127.313$, $p < 0.001$; group mean scores ordered from mild to severe were anomia (*M* = 84.99, *SD* = 6.57, range 68-93), conduction aphasia (*M* = 70.73, *SD* = 9.59, range 48-90), and Wernicke's aphasia (*M* = 51.50, *SD* = 13.81, range 28-74).

RQ1: Comparisons between fluent aphasia subgroups on formulaic language use

The primary research question asked whether there were between-group differences on formulaic language usage during monologic discourse tasks in individuals with fluent aphasias. Figure 1 demonstrates mean percentages of items produced in each formulaic language category by aphasia subtype. Statistically significant differences in mean percentages between groups were found for the following formulaic language categories: phatic interjections, H(2) = 11.539, P = 0.003, $\eta^2 = 0.068$; speech formulas, H(2) = 9.200, P = 0.010, $\eta^2 = 0.051$; idioms and proverbs, H(2) = 8.680, P = 0.013, $\eta^2 = 0.047$; and lexical bundles, H(2) = 33.083, P < 0.001, η^2= 0.220.

Posthoc comparisons provided insights into patterns of formulaic language usage. For individuals with conduction aphasia, mean percentages of phatic injections (i.e., yes/no variants) were higher than for the other two subtypes: conduction *M* = 2.50%, *SD* = 1.95% versus anomia *M* = 0.96%, *SD* = 0.22%, H = 25.447, P = .003, versus Wernicke's *M* = 1.02%, *SD* = 1.79%, H = 27.193, P = 0.035. Mean percentages of idioms and proverbs were significantly lower for individuals with conduction aphasia (*M* = 0.03%, *SD* = 0.09%) compared to anomia (*M* = 0.09%, *SD* = 0.14%), H = 20.196, P = 0.003; in contrast, mean percentages of speech formulas showed the opposite pattern: conduction (*M* = 4.57%, *SD* = 2.87%) versus anomia (*M* = 3.10%, *SD* = 1.87%), H = 23.965, P = .007. Finally, mean percentages of lexical bundles were significantly lower for individuals with anomia (*M* = 0.91%, *SD* = 0.56%) than either conduction (*M* = 1.84%, *SD* = 1.23%), H = 37.892, P < 0.001, or Wernicke's aphasia (*M* = 1.98%, *SD* = 1.12%), H = 39.392, P < 0.001.

A final interesting result was the statistically significant difference in filler use between groups, H(2) = 8.673, P = 0.013, $\eta^2 = 0.047$. As mentioned previously, this analysis was derived using the production of word and non-word fillers divided by total words in the sample including fillers (note: non-word fillers were excluded from total word counts for analyses in all other categories). Posthoc comparisons demonstrated that the effect was due to significantly lower mean percentages of filler production in individuals with Wernicke's (*M* = 6.56%, *SD* = 5.69%) versus anomic aphasia (*M* = 12.25%, *SD* = 8.27%), H = 29.240, P = .010. A follow up analysis was used to examine whether the between-group difference was due to both real- and non-word fillers; when non-word fillers were excluded from the analysis, there was no statistically significant difference across subtypes, H(2) = 1.794, P = 0.408, indicating that differences in filler production were almost entirely attributable to "uh" and "um".

RQ2: Comparisons of formulaic language use across discourse tasks for individuals with fluent aphasias

The next analysis examined production of formulaic language usage according to discourse task. Because of their over-representation, fillers were removed from this analysis. There was a statistically-significant difference in the mean percentage of formulaic language use across the four tasks

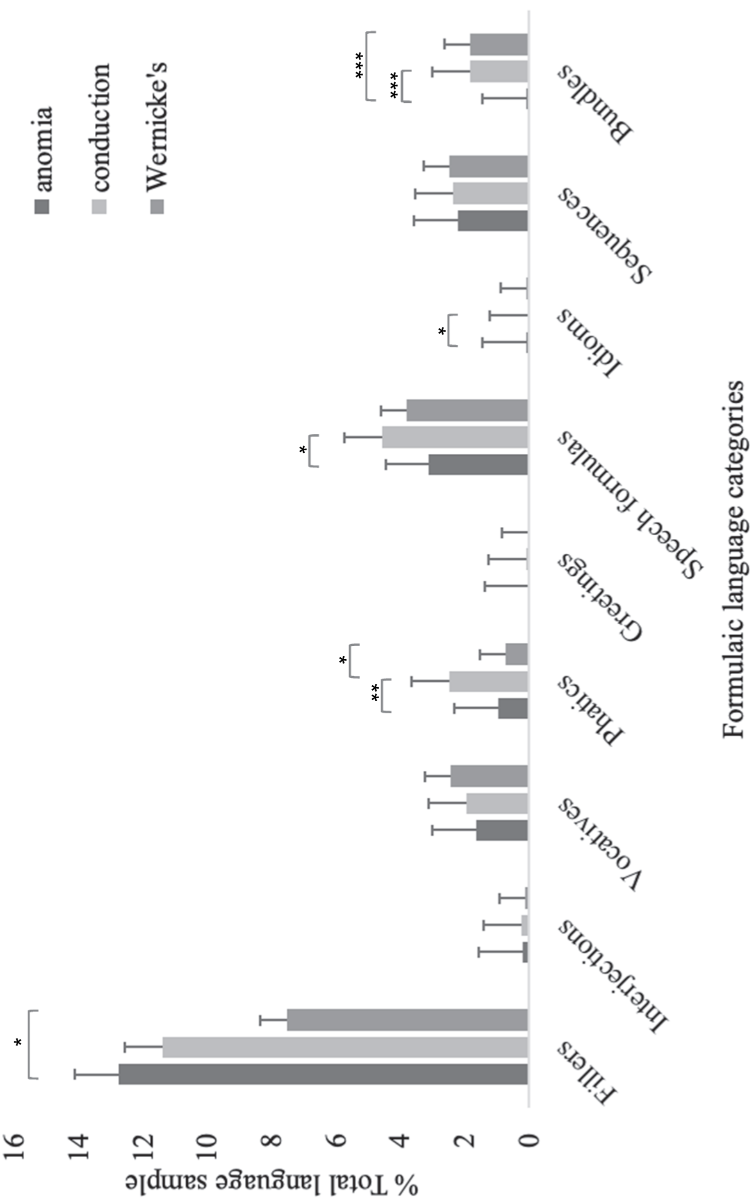

Figure 1. Percentages of formulaic language use by item type and participant group. Note: *p*-values = * < .05, ** < .01, *** < .001.

(Cinderella *M* = 8.34%, *SD* = 6.32%; Stroke story *M* = 11.23%, *SD* = 5.78%; Speech status *M* = 17.56%, *SD* = 16.09%; Important event *M* = 11.21%, *SD* = 7.00%), $\chi^2(3) = 74.337$, $p < 0.001$. Using Wilcoxin's signed-rank tests, the only pairwise comparison that was not statistically significant was the difference between the Important event and Stroke story recounts (Cinderella versus Stroke: H(2) = 5.222, P < 0.001, $\eta^2 = 0.030$; Cinderella versus Speech: H(2) = 8.486, P < 0.001, $\eta^2 = 0.053$; Cinderella versus Important: H(2) = 3.823, P < 0.001, $\eta^2 = 0.020$; Stroke versus Speech: H(2) = 3.264, P = 0.001, $\eta^2 = 0.016$; Stroke versus Important: H(2) = 1.399, P = 0.162; Important versus Speech: H(2) = 4.663, P < 0.001, $\eta^2 = 0.026$).

To further explore the effects of discourse task, production patterns were examined for each fluent aphasia subtype. Friedman tests were used to compare within group effects of discourse task for each formulaic language category. Because of the large number of comparisons in this analysis, the Bonferroni adjusted alpha was 0.002. Interjections, greetings, and idioms and proverbs were not analysed due to low overall usage (< 1%). Results for the remaining categories are found in Table 1.

Formulaic language usage was most affected by discourse task in individuals with anomia as illustrated by statistically significant differences in production of vocatives, phatics, speech formulas, and formulaic sequences. The Speech status prompt elicited the highest mean percentage of phatics and speech formulas as compared to the Cinderella story prompt, which elicited the lowest mean percentages of these items. For formulaic sequences, mean group percentages were higher in response to the Stroke prompt than in any other discourse task. Pairwise comparisons for vocatives did not demonstrate any statistically significant differences between discourse tasks using the conservative alpha.

Table 1. Results of formulaic language usage by aphasia subtype, discourse task, and formulaic language category.

		Percentages by formulaic language category					
Aphasia Subtype	Discourse task	Fillers	Vocatives	Phatics	Formulas	Sequences	Bundles
Anomia	Cinderella	13.8 (9.8)	1.4 (1.4)	0.2 (0.8)	2.4 (2.4)	1.8 (1.8)	0.6 (0.8)
	Stroke	11.9 (7.4)	1.6 (1.2)	1.3 (2.9)	2.9 (2.2)	2.4 (1.8)	1.1 (1.1)
	Speech	9.5 (11.0)	1.7 (3.6)	4.2 (9.6)	8.1 (1.3)	1.3 (1.9)	1.3 (2.7)
	Event	13.4 (9.2)	1.8 (1.9)	0.5 (1.2)	3.8 (2.7)	1.4 (1.3)	0.9 (1.1)
Statistical significance		χ^2=12.60, *p*=.006	χ^2=14.33 *p*=.002	χ^2=58.38, *p*<.001*	χ^2=29.39, *p*<.001*	χ^2=27.26, *p*<.001*	χ^2=6.11, *p*=.107
Conduction	Cinderella	12.0 (9.3)	1.7 (1.7)	1.3 (5.8)	3.8 (3.6)	1.8 (1.5)	1.8 (2.4)
	Stroke	10.9 8.1)	1.9 (1.4)	3.4 (4.9)	4.6 (3.0)	2.3 (1.8)	2.0 (1.5)
	Speech	8.0 (7.2)	1.8 (2.8)	3.1 (4.9)	8.8 (10.3)	1.9 (2.5)	2.6 (3.7)
	Event	12.3 (8.7)	2.3 (2.3)	3.3 (6.0)	4.3 (3.2)	1.7 (1.5)	1.6 (1.9)
Statistical significance		χ^2=9.67, *p*=.022	χ^2=7.49 *p*=.058	χ^2=24.48, *p*<.001*	χ^2=14.01, *p*=.003	χ^2=9.32, *p*=.025	χ^2=6.95, *p*=.074
Wernicke's	Cinderella	8.1 (9.1)	1.9 (1.3)	0.4 (1.1)	2.8 (2.4)	2.6 (3.5)	1.9 (1.5)
	Stroke	6.9 (6.3)	2.2 (1.8)	1.1 (1.6)	4.1 (2.5)	2.6 (2.6)	2.0 (1.4)
	Speech	8.5 (8.3)	1.0 (1.7)	1.9 (4.6)	7.2 (7.8)	2.8 (4.8)	2.0 (3.9)
	Event	8.1 (6.7)	3.1 (2.4)	0.6 (1.4)	4.6 (4.0)	1.7 (1.9)	1.7 (1.4)
Statistical significance		χ^2=3.35, *p*=.341	χ^2=10.11 *p*=.018	χ^2=8.64, *p*=.034	χ^2=3.39, *p*=.335	χ^2=4.45, *p*=.217	χ^2=4.39, *p*=.222

*Adjusted alpha due to risk of type I error from multiple comparisons (24 comparisons per subtype) is p < .002.

By comparison, formulaic language production in individuals with conduction and Wernicke's aphasias was much more consistent across discourse tasks. For the subgroup of conduction aphasia, there was a significantly lower percentage of phatics produced in response to the Cinderella prompt than for the other recount tasks. There were no statistically significant differences in mean percentages across discourse tasks for any formulaic language category for participants with Wernicke's aphasia.

RQ3: Relationships between language performance and formulaic language use in fluent aphasia

Unlike the previous study with individuals with Broca's aphasia, there was no relationship between WAB-R AQ and total percentage of formulaic language, r = 0.043, p = 0.611. There were statistically significant correlations between WAB-R AQ and lexical bundles, r = -0.272, $p < 0.001$, r^2 = 0.074, as well as fillers, r = 0.243, p = 0.004, r^2 = 0.059. These categories only accounted for a small amount of the variance in WAB-R AQ (7.4% and 5.9% respectively), and the direction of these correlations was unexpected: individuals with higher WAB-R AQ produced more fillers and fewer lexical bundles. These findings will be addressed in the discussion.

RQ4: Patterns of formulaic language use in fluent versus non-fluent aphasia

In order to enable a comparison of usage patterns seen in individuals with fluent versus nonfluent aphasias, we ran a correlation matrix with data from this study's participants showing relationships between formulaic language categories (Table 2). The strongest relationships were seen with the use of yes/no variants. Phatic use was strongly correlated with the production of both interjections and speech formulas accounting for 26% and

Table 2. Pearson's correlation matrix (N = 142) showing relationships between formulaic language categories.

	1	2	3	4	5	6	7	8	9
1 Fillers	-	-0.004	.306**	.322**	0.068	.309**	0.142	0.118	-0.030
	-	0.959	<0.001	<0.001	0.420	<0.001	0.091	0.164	0.723
2 Vocatives	-0.004	-	-0.115	0.008	-0.042	.235**	-0.071	-0.021	.232**
	0.959	-	0.173	0.925	0.620	0.005	0.404	0.807	0.005
3 Inter-jections	.306**	-0.115	-	.515**	.252**	.249**	0.110	-0.007	-0.102
	<0.001	0.173	-	<0.001	0.003	0.003	0.193	0.937	0.231
4 Phatics	.322**	0.008	.515**	-	.333**	.609**	-0.121	0.058	-0.002
	<0.001	0.925	<0.001	-	<0.001	<0.001	0.152	0.492	0.985
5 Greetings	0.068	-0.042	.252**	.333**	-	0.088	-0.028	-0.135	-0.014
	0.420	0.620	0.003	<0.001	-	0.300	0.742	0.110	0.869
6 Speech formulas	.309**	.235**	.249**	.609**	0.088	-	-0.158	.236**	.287**
	<0.001	0.005	0.003	<0.001	0.300	-	0.060	0.005	0.001
7 Idioms	0.142	-0.071	0.110	-0.121	-0.028	-0.158	-	-0.118	-0.120
	0.091	0.404	0.193	0.152	0.742	0.060	-	0.161	0.156
8 Formulaic sequences	0.118	-0.021	-0.007	0.058	-0.135	.236**	-0.118	-	0.137
	0.164	0.807	0.937	0.492	0.110	0.005	0.161	-	0.103
9 Lexical bundles	-0.030	.232**	-0.102	-0.002	-0.014	.287**	-0.120	0.137	-
	0.723	0.005	0.231	0.985	0.869	0.001	0.156	0.103	-

**$p < 0.01$.

37% respectively of the variance in scores. Phatic usage was also moderately correlated with greetings and fillers. Speech formula production was related to all formulaic language categories except greetings/farewells and idioms/proverbs. These results will be compared to findings from individuals with Broca's aphasia in the previous study.

Discussion

This study aimed to describe formulaic language usage in individuals with fluent aphasias using a retrospective dataset. Results illustrated statistically significant differences in both total percentage and types of formulaic items across fluent aphasia subtypes. In addition, formulaic language production patterns in individuals with anomic aphasia were most affected by discourse task as compared to individuals with conduction and Wernicke's aphasias. There was no relationship between language impairment severity as measured by WAB-R AQ and percentage of formulaic language produced, but there were interesting relationships between formulaic language item types. In addition to interpreting these findings, we will compare formulaic language profiles in individuals with fluent aphasias to individuals with Broca's aphasia described in the previous study (Torrington Eaton & Burrowes, 2021).

Although differences were observed across subtypes of fluent aphasia, our hypothesis - that individuals with conduction and anomic aphasia would have similar formulaic usage profiles as compared to individuals with Wernicke's aphasia- was not supported. In fact, formulaic language profiles in individuals with conduction aphasia were more similar to individuals with Broca's than anomic aphasia as characterized by high percentages of phatics (yes/no responses) and speech formulas. Individuals with anomic aphasia, with the mildest language impairment as measured by WAB-R AQ group mean, produced a low percentage of lexical bundles and high percentage of non-word fillers comparable to individuals with Broca's aphasia. Formulaic language profiles in individuals with Wernicke's aphasia fell somewhere in between the other groups, although the low percentage of non-word fillers- comparable to healthy controls (Torrington Eaton & Burrowes, 2021)- was a distinctive feature.

Although these results were somewhat unexpected, there are clearly limitations to using clinical classifications from the WAB-R. Researchers have not only highlighted discrepancies between clinical judgments and WAB-R classifications (Clough & Gordon, 2020), but have questioned the utility of these subtypes for research and clinical purposes (Brownsett et al., 2019; Hoffman & Chen, 2013; Wilson et al., 2023). Future studies should instead analyse how formulaic language usage maps onto specific propositional language skills in aphasia. In addition, because formulaic language is inherently different from propositional language (i.e., the neural bases; Sidtis et al., 2018), researchers should explore a range of variables such as site of lesion, level of education, motor speech skills, and cultural and linguistic background to explain this and the previous study's observed patterns.

Most studies that have examined effects of discourse type in individuals with aphasia have compared propositional language use across genres (Bryan et al., 2016, Dipper et al. 2018; Leaman & Archer, 2023; Stark, 2019). The current and previous studies considered formulaic language use in two monologue-level discourse genres, narrative and personal recount, and three conversational topics within the latter.

Results from this study replicated findings from individuals with Broca's aphasia; the Speech status prompt elicited by far the highest percentage of formulaic language followed by the other personal recounts, whereas the Cinderella narrative elicited the lowest percentage of formulaic language. As suggested by Williams et al. (1994) in their study of discourse effects on propositional content, topic familiarity and difficulty of the discourse task/genre influence the verbal output of PWA. Although this study adds to the evidence base on discourse task effects, interpretation is limited in descriptive, retrospective research. In the future, quasi-experimental designs should be used to analyse factors that might explain differences in propositional and non-propositional language use across a broader range of discourse tasks, topics and genres to include conversation.

Despite limitations in WAB-R aphasia classification, a unique contribution of this study was the examination of differences in formulaic language usage according to aphasia subtype and discourse elicitation prompt. As demonstrated in the results, individuals with anomic aphasia were most affected by discourse task. This group used more speech formulas and yes/no responses when asked about their current speech status (e.g., *I'm okay, It's alright, yep*), and more formulaic sequences when narrating the events of their stroke (e.g., *in the morning, and suddenly, and then)*. Perhaps a more interesting finding is that individuals with conduction and Wernicke's aphasias were not similarly influenced by discourse task. A better understanding of formulaic language production based on aphasia subtype and discourse genre and/or conversational topic has interesting clinical applications. For example, research could explore the effects of purposefully embedding, eliciting, or emphasizing formulaic language in interventions that target conversational exchange (Northcott et al., 2021; Volkmer et al., 2022; Whitworth et al., 2015); in doing so, the clinician might promote verbal output by capitalizing on individuals' intact pragmatics skills without increasing cognitive demand.

The final analyses in this study explored relationships between formulaic language and aphasia severity. In the 2021 study, it was found that individuals with severe language impairment including limited verbal output and deficits in naming and repetition (i.e., individuals with nonfluent aphasia) heavily rely on formulaic language to communicate. Unlike the previous study with individuals with Broca's aphasia, there was no relationship between the percentage of formulaic language produced by individuals with fluent aphasia and WAB-R AQ. With the exception of a handful of items (e.g., conversational question: "how are you today?"; repetition: "no ifs, ands or buts"; sentence completion: "the grass is ___", "they fought like cats and ___", "roses are red, violets are ___"), the WAB-R assesses propositional language. Additionally, as observed by a number of researchers (e.g., Fromm et al., 2022), WAB-R AQ encompasses a number of skills beyond just spontaneous language, so perhaps it would be more surprising if there were a relationship for individuals with fluent verbal expression.

There were two statistically significant correlations found between WAB-R AQ and types of formulaic language. First, there was a positive relationship between WAB-R AQ and filler production. This finding aligns with results shown in Figure 1 in which individuals with anomic aphasia- with the highest WAB-R AQ group mean- produced the highest percentage of fillers. In contrast, individuals with Wernicke's aphasia- with the lowest WAB-R AQ group mean- produced the lowest percentage of fillers. This pattern is consistent with research showing differences in self-repair tendencies across individuals with fluent aphasia (e.g., Fromm et al., 2022). The second statistically significant correlation demonstrated a negative relationship between production of lexical bundles and WAB-R AQ, which also aligns with what was observed in the group results (Figure 1); specifically, individuals with anomic aphasia- with the mildest level of severity- produced the lowest percentage of lexical bundles.

The final result in this study demonstrated relationships between types of formulaic language used by individuals with fluent aphasia. Phatics were strongly correlated with speech formulas and interjections, and moderately correlated with greetings and fillers. This finding replicates results from the previous study with individuals with Broca's aphasia, which suggests a relationship between relying on a conversational partner to provide content (e.g., responding with a yes/no variant) and production of pragmatically useful pre-packaged phrases (e.g., *oh no!, gotta go, no problem*).

In conclusion, this study adds to the research base on formulaic language production patterns in individuals with post-stroke aphasia. Though we acknowledge the limitations of results derived from descriptive, retrospective research, these findings establish a foundation toward eventual clinical application. Future research that examines relationships between cognitive-linguistic profiles, discourse tasks and genres, and formulaic language production patterns can inform assessment and differential diagnosis practices in aphasia, and be used to augment existing or create novel language interventions that capitalize on an individual's linguistic strengths.

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Disclosure statement

The authors report there are no competing interests to declare.

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