Understanding Fluency in Aphasia

Sharice Clough, MA, CF-SLP & Jean K. Gordon, PhD, CCC-SLP

University of Iowa, Department of Communication Sciences & Disorders

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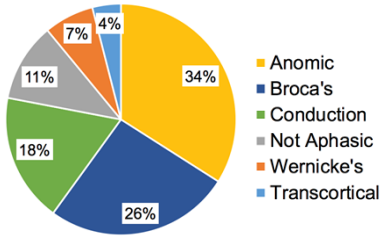
Background

- One of the most common ways of describing aphasia is by fluency.
- Both the BDAE and the WAB attempt to capture the **multidimensional nature of fluency** using ratings on dimensions such as prosody, paraphasia, grammaticality, word-finding difficulty, and articulatory effort.
- However, they have demonstrated **poor agreement** on aphasia classifications, including fluent vs non-fluent distinctions.[1]
- Perceptual ratings by practicing speech-language pathologists have identified several features that predict fluency judgements, including:
  - Grammaticality, articulatory effort, and word-finding difficulties[2]
  - Speech productivity, speech rate, and audible struggle[3]
- We propose a shift away from the fluent/non-fluent dichotomous categorization toward a focus on **identifying the underlying contributors** to disrupted speech fluency.

Methods

- **Participants** included **254 people with aphasia (PwA)** from the AphasiaBank database, representing a range of WAB aphasia types:
  - Each PwA was **classified by WAB** and **clinical impression** as having fluent (F) or nonfluent (NF) aphasia.
  - Each produced a **Cinderella story** narrative.

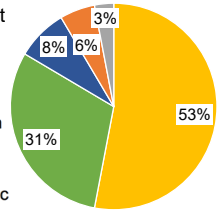


- **Objective measures** of connected speech predicted to underlie fluency were extracted from the Cinderella stories using CLAN.
  - All inter-correlations were <.500 or >-.500 to reduce collinearity.

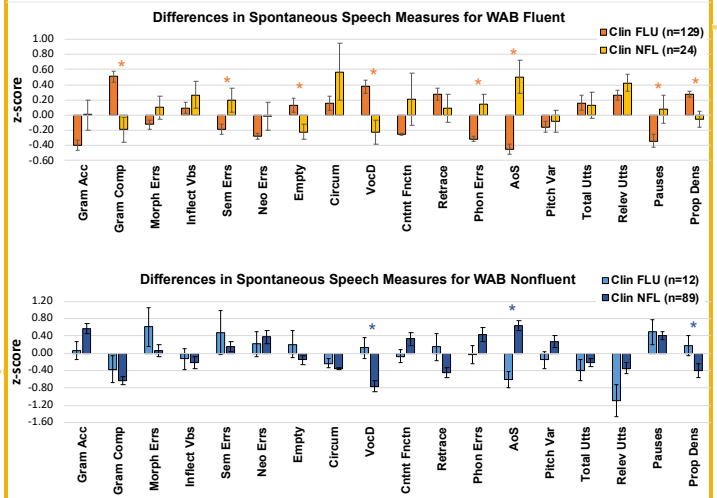
Underlying Component	Dimension	Predictor Variable
Grammatical competence	Grammatical accuracy	% Grammatical utterances
	Grammatical complexity	% Complex grammatical relations
	Morphological accuracy	% Morphological errors
	Morphological complexity	% Verbs inflected
Lexical retrieval ability	Lexical accuracy	% Semantic errors; % Neologistic errors
	Lexical specificity	% Empty speech utterances
	Lexical efficiency	% Circumlocutory utterances
	Lexical diversity	VocD
Grammatical and lexical dimensions		Content:function word ratio; Retracing
Facility of speech production	Phonological encoding	% Phonological errors; % Neologistic errors
	Motor speech	Apraxia of speech (Y/N); Dysarthria (Y/N)
	Melodic line	Pitch variability (SD of F_0)
Grammatical, lexical, speech & content dimensions		Total utterances; % Pauses; % Relevant utterances; Propositional density

Results

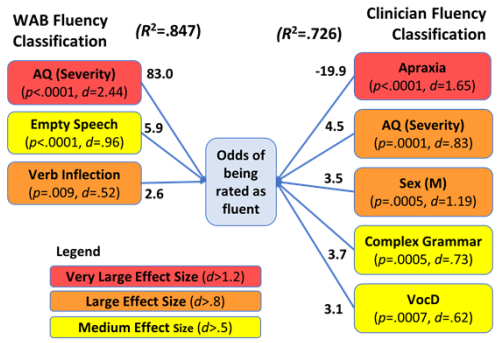
- **Mismatches (n=36) by Aphasia Type:** Agreement on fluency category was 86% overall, similar for fluent (84%) and nonfluent (88%) aphasia.
  - Of **153 participants with fluent aphasia**, clinicians classified 24 as nonfluent.
  - Of **101 Pw NF aphasia**, clinicians classified 12 as fluent.
  - Agreement was lowest for **anomic and conduction aphasia**.



- **Comparison of Spontaneous Speech Measures for PwA with Mismatching Clinician Fluency Impressions.** Spontaneous speech measures were transformed to z-scores to facilitate comparison.



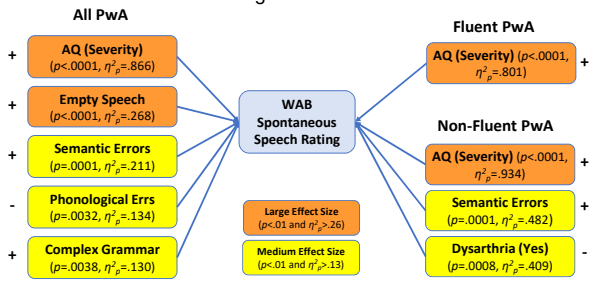
- **Logistic Regression*:** WAB Fluency was predicted primarily by **aphasia severity, empty speech,** and the use of **verb inflections.**
  - Clinicians were influenced by **apraxia, complex grammar, lexical diversity,** and **sex** of the PwA.



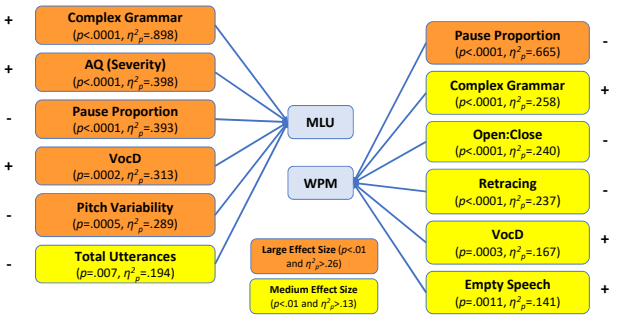
(*Note: Results are shown only for variables with $p<.01$ *and* medium to large effect sizes.)

Results (continued)

- **Linear Regressions:** Fluency is often measured with the **Spontaneous Speech rating scale of the WAB**. This largely reflects severity. Lexical specificity and accuracy and grammatical complexity also contribute.
  - Different variables affect ratings for fluent and nonfluent PwA.



- **Linear Regressions:** Fluency is also measured by **mean utterance length** or **speech rate**. Both indices are themselves influenced by multiple (lexical, grammatical, and speech) dimensions.
  - MLU is most strongly affected by severity and grammatical complexity.
  - WPM is further influenced by lexical variables (VocD, empty speech).



Conclusions & Future Directions

- Fluency categories based on the WAB largely reflect **aphasia severity**.
- Clinicians are sensitive to differences in a variety of spontaneous speech dimensions that the WAB does not capture.
  - In making fluency judgements, clinicians are influenced by variables contributing to underlying components of fluency: **grammatical competence, lexical retrieval, and speech production.**
- By providing objective and standardized methods of capturing these underlying variables, we aim to improve diagnostic reliability of fluency.

References

1. **Swindell, C.S., Holland, A., & Fromm, D. (1984).** *Classification of aphasia: WAB type versus clinical impression.* Paper presented at the Clinical Aphasiology Conference.
2. **Gordon, J.K. (1998).** The fluency dimension in aphasia. *Aphasiology, 12*(7/8), 673-688.
3. **Park, H., Rogalski, Y., Rodriguez, A.D., Zlatar, Z., Benjamin, M., Harnish, S., . . . Reilly, J. (2011).** Perceptual cues used by listeners to discriminate fluent from nonfluent narrative discourse. *Aphasiology, 25*(9), 998-1015.