





Introduction

Reading is an important life participation activity, People with aphasia (PWA) often experience chronic reading difficulties which negatively impact their quality of life (Brookshire et al., 2014; Lee et al., 2015).

- Some PWA find text-to-speech (TTS) useful in improving their reading speed or comprehension (Wallace et al., 2022)
- Word length and word frequency may affect silent reading when using TTS
- Eye-tracking is one way to study this

Aim: Explore the relationship between eye gaze behaviors and (1) word length, and (2) word frequency when PWA read narratives across two reading conditions (TTS vs. Reading Only [RO]).

| Methods |
|---------|
|---------|

*Data extracted from Knollman-Porter et al., 2023

Participants

- 9 PWA (ages 37 76 years)
- 5 men & 4 women
- 3 Broca's; 3 Anomic; 3 Transcortical Motor

Materials

- Tobii Dynavox Pro Spectrum[©] Eye Tracker
- 20 Narratives
- Microsoft© "David" voice

Experimental Procedures

- Eye-Tracking Calibration & Instruction Review (1 Practice Narrative)
- 2. 10 TTS & 10 RO narratives (randomized order; sets of 5)
- 2 Gist Questions per narrative

Analysis

Pre-Analysis

- Coding of Eye Tracking Data in Microsoft Excel®
- Word fixated, length, position, #, fixation duration, fixation count • Lexical Variables
- Word length & frequency: COCA database; Excel© =LEN() function
- Only nouns, adjectives, adverbs, and verbs included in the analysis

| Outcome Measure | Definition |
|---|---|
| Probability of First Pass Fixation (FPF) | If a word was fixated on |
| Gaze Duration (GD) | Sum of all fixations on a word before the read a saccade to a following word in the sentend |
| First Fixation Duration (FFD) | The time readers spend fixating on a word t their gaze lands on it as they move through |
| Total Fixation Duration (TFD) | Total word reading time |

Statistical Analysis in R:

- Binary Measure: Logistic Mixed Effects Models
- Continuous Measures: Linear Mixed Effects Models

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Reading Narratives with Text-to-Speech Technology: How do Word Length and Word Frequency Affect Eye Movements?

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Results

Word Length Effects

• Word length had a significant positive main effect on **FPF** ($\beta = 2.79$; p<.001), **GD** ($\beta = 1.61e$ -1; p<.001), and **TFD** (β = 0.43; p<.001)





Word Frequency Effects

• Word frequency had a significant negative main effect on **FPF** (β = 0.70; p<0.001) and **TFD** $(\beta = 0.06; p < 0.05)$



The more frequent the word... The less likely a reader was to fixate on it The less likely the reader was to fixate on it multiple times

- ader makes the 1st time a sentence



The longer the word...

- The more likely a reader was to fixate on it
- The greater the sum of fixations on that word during the reader's first pass
- The more often the reader fixated on it multiple times





Clinical Implications:

- TTS may help PWA process longer words in narratives

Limitations:

- Small sample size (n = 9)

Future Research Directions:







Results Cont.

Discussion

Like neurotypical adults (Rayner, 2004, 2009), PWA require

increased processing time for longer and low-frequency words

Reiterating findings at the sentence level (DeDe, 2017; Huck et al., 2017; Rayner et al., 2004)

Condition alone did not have a significant effect on eye movements

• Individualized reading support for PWA is critical for success

• Clinicians should consider word length & frequency when designing treatment materials to best support comprehension

• Retrospective design (narratives not designed for this analysis)

• Most with high reading scores

• Participant C as an outlier (letter-by-letter reading)

Findings can only be interpreted with reference to content words TTS Methodology (i.e., restricted manipulation, ignoring output)

• Experimental narrative design (word length & frequency) Enhanced TTS Implementation (customization & improved analysis) • Increasing sample size to improve generalizability

