Sentence-planning strategies in adults who stutter: An eye-tracking study

Kerianna Frederick & Yi Ting Huang (University of Maryland College Park)

Stuttering is a developmental disorder involving abnormal breaks in speech production, and affects over 3 million individuals in the US. Although the hallmarks of stuttering are highly visible (e.g. silent/audible repetitions, prolongation of word/syllables), it remains unclear what production processes give rise to these patterns. At the single-word level, adults who stutter exhibit similar speech-initiation times as typically fluent peers (Hennessey et al., 2008), but may experience increased challenges with infrequent words (Newman et al., 2007). At the sentence level, adults who stutter are slower to initiate speech, particularly for syntactically complex sentences (Logan, 2003; Tsiamtsiouris & Cairns, 2009). This suggests that stuttering impacts production at multiple levels. However, since past studies investigate words and sentences separately (i.e., measuring one or the other), they leave open how these processes interact and how adults who stutter differ from typically fluent peers. Tackling this gap in knowledge is critical since sentences convey thought through constituent words. Thus, the demands of early-arriving words may impact planning of later-arriving elements differently across speakers.

To compare sentence production in adults who stutter and typically fluent adults, this study used an eye-tracking while speaking task. Groups (n=9 in each) were matched on age, gender, and education. On each trial, participants saw displays of three pictures (A, B, C) and produced sentences in the frame "A and B are above C." The ease of lexical retrieval (frequent/more codable vs. infrequent/less codable) and word position in the sentence (A vs. B) were manipulated, leading to four trial types: 1) EasyA/EasyB (e.g., "*car and baby*"), 2) EasyA/HardB (e.g., "*car and wood*"), 3) HardA/EasyB (e.g., "*fish tank and baby*"), 4) HardA/HardB (e.g., "*fish tank and wood*"). Picture C always involved simple shapes (e.g., *circle*). In past work (Griffin, 2001), typically fluent adults generate longer fixations when producing infrequent words and less codable pictures. Moreover, they begin encoding later-arriving pictures (e.g., B) before they finish articulating early-arriving elements (e.g., A). Importantly, if production challenges in adults who stutter are limited to lexical retrieval, then infrequent/less codable words may lead to longer fixation durations relative to typically fluent peers. However, groups may reveal similar effects of word position. In contrast, if properties of early-arriving pictures lead adults who stutter to adopt distinct strategies for planning later-arriving elements, then fixations may differ according to both the ease of lexical retrieval and word position, relative to typically fluent peers.

To examine lexical-retrieval effects across groups, we first separated trials based on properties of picture A and examined total-fixation times on picture B. When lexical retrieval for picture A had been difficult, all speakers generated longer fixations when picture B was also difficult compared to easy ($p<.01$). There was no effect of group ($p>.60$). However, when picture A was easy, lexical-retrieval effects on picture B were exaggerated in adults who stutter compared to typically fluent peers (lexical ease x group, $p<.05$). To understand whether this reflects greater challenges with lexical retrieval or distinct planning strategies, we separated trials based on group and examined gaze duration on picture A. Typically fluent adults revealed a paradoxical pattern: Fixations were *longer* when picture A was *easy* relative to difficult ($p<.01$), and this difference was marginally greater when picture B was difficult (lexical ease x position, $p<.10$). Thus, when picture A was easy to retrieve, typically fluent adults planned the next element. In contrast, for adults who stutter, fixations during picture A were not affected by lexical properties or word position ($p's>.30$). This absence of pre-planning may explain why adults who stutter experienced exaggerated difficulty on picture B. While typically fluent peers sometimes planned picture B while fixating on picture A, adults who stuttered always planned picture B while on B. Importantly, when retrieving picture A was made difficult, this blocked pre-planning for all speakers and group differences on picture B disappeared. Together, these findings suggest that adults who stutter may adopt less flexible strategies for planning words in sentences. We will discuss this work in relation to prior production research (typical and atypical).