The Effects of Time Pressure on Speech Fluency in Aging Adults: Comparisons With Divided Attention

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The Effects of Time Pressure on Speech Fluency in Aging Adults:
Comparisons With Divided Attention

Caleb Henderson Sanford

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Science

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ABSTRACT

The Effects of Time Pressure on Speech Fluency in Aging Adults: Comparisons With Divided Attention

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Master of Science

This study investigated the impacts of dual task and time pressure conditions on the speech fluency of 60 neurotypical adults between the ages of 26 and 85. Participants retold short stories in baseline, time pressure, dual task, and combined dual task and time pressure conditions. Dependent variables included five measures of speech fluency: words per minute (WPM), fillers per verbalization, false starts and repetitions per verbalization, extended pauses per utterance, and speech naturalness. Each of these variables was compared between age groups of younger, older, and elderly adults and across conditions. Results reveal that time pressure causes speech rate to increase across age groups but combining time pressure with a dual task condition mitigates this effect in elderly speakers. Additionally, younger adults are perceived to have more natural speech compared to older and elderly adults. Speakers across age groups perform similarly in all other variables of speech fluency, with notable changes in fluency under the combined dual task and time pressure condition compared to other conditions. These findings suggest that while speakers do not always become less fluent as attentional demands increase, the combination of dual task and time pressure conditions can cause attentional demands to surpass capacity and/or resource allocation thresholds for fluent speakers. Future research should continue investigating the effect of time pressure and other divided attention conditions on typical speakers and those with communication disorders to establish methods for optimizing conditions for effective communication in everyday situations.

Keywords: speech fluency, divided attention, dual task, time pressure
ACKNOWLEDGMENTS

I express gratitude to all who have given encouragement and support throughout the completion of this thesis. Dr. Harmon has provided guidance far beyond expectation and reinforced my confidence in moving forward through any difficulties this project has posed. I also thank Dr. Dromey and Dr. Nissen for their help in serving on my committee. Additionally, I recognize the significant contributions of my fellow graduate and undergraduate students who serve in the Aphasia Lab. Data collection for this project was funded through a McKay School of Education Experiential Learning Grant. Most importantly, I thank my family, who provide me with the love and goodness that keep my foundation solid and maintain my ability to pursue a career in speech-language pathology.
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DESCRIPTION OF THESIS STRUCTURE AND CONTENT

This thesis, *The Effects of Time Pressure on Speech Fluency in Aging Adults: Comparisons With Divided Attention*, is formatted according to both thesis requirements and journal article format. The preliminary pages of this thesis fulfill guidelines for university submission, while the remainder of the thesis is written with journal article structure. The annotated bibliography is included in Appendix A. Appendix B contains the Institutional Review Board-approved research consent form for participants in the study, and Appendix C contains the training protocol for the Codes for the Human Analysis of Transcripts (CHAT) system.
Introduction

Communicative interactions can occur under a wide variety of conditions. Some exchanges may take place with few extraneous environmental or social demands. However, individuals’ spoken language may frequently be constrained by factors such as background noise, the need to perform other tasks while speaking (dual tasking), or feelings of time pressure. While the effects of background noise (Harmon et al., 2021) and dual tasking (Harmon et al., 2019; Kemper et al., 2005; Kemper et al., 2011; Kemper et al., 2010) on speech fluency have been investigated, time pressure has received less attention as a potential contributor to communicative breakdowns. Despite a lack of empirical investigation, people across a variety of communication disorders seem to experience difficulty communicating under time pressure conditions. Understanding the impact of dual task and time pressure conditions on the speech fluency of typical speakers is a necessary precedent to similar investigations of populations with communication disorders.

Attention and Dual Tasks

The interconnectedness of attention and spoken language is highlighted by evidence reflecting linguistic deficits induced by increased attentional demands (Cahana-Amitay & Albert, 2015), but the relationship between these two processes is ambiguous. Because attentional and linguistic resources are simultaneously engaged during discourse, it is difficult to define how each is utilized relative to the other. Such ambiguity can be addressed by conceptualizing attention within several subtypes. One model suggests that sustained attention, vigilance, and arousal fall within the category of basic attention, while focused, alternating, and divided attention are complex types of attention (Cahana-Amitay & Albert, 2015).
Divided attention or dual tasking, which involves performing multiple tasks simultaneously, may be considered the most cognitively demanding type of attention and has a pronounced impact on spoken language and by extension, speech fluency. The nature of each task within dual task paradigms can take many forms. Spoken language components often include phoneme monitoring tasks (Ganushchak & Schiller, 2006; Sasisekaran & Donohue, 2016), nonword repetitions (Whitfield & Goberman, 2017), or monologic tasks stimulated by open-ended questions (Eichorn et al., 2016; Kemper et al., 2005; Kemper et al., 2011; Kemper et al., 2010), picture descriptions (Murray et al., 1998), or story retells (Harmon et al., 2019, 2020; Jou & Harris, 1992; McNeil et al., 2004). These may be paired with motor tasks such as walking, cognitive tasks (Kemper et al., 2005), rotor tracking (Kemper et al., 2011; Kemper et al., 2010; McNeil et al., 2004; Whitfield & Goberman, 2017), tone discrimination (Harmon et al., 2019; Murray et al., 1998; Sasisekaran & Donohue, 2016), or solving simple math equations (Jou & Harris, 1992).

The multitude of paradigms through which divided attention can be tested creates significant variability in outcomes. Therefore, it is essential to understand the paradigms used for dual task experiments prior to analyzing outcomes within the dual task literature. McNeil et al. (2004) corrected a common assumption made about resource allocation during dual tasks: that the cognitive functions utilized in single versus dual tasks are inherently the same. This idea suggests that when two previously performed single tasks are performed simultaneously as a dual task, cognitive resources used for the tasks in isolation are simply added together. Then, if the sum exceeds allotted cognitive capacity, some task performance suffers, creating disparities between results in single and dual task conditions. However, this assumption ignores the possibility that a dual task context may stimulate different modes of cognitive resource
recruitment and allocation (McNeil et al., 2004). Thus, when considering the effects of a dual task paradigm, the whole may often be less than or greater than the sum of its parts due to the interactions between innate and learned characteristics held by an individual. The extent to which a dual task may inhibit or facilitate speech fluency can be mediated by numerous factors such as age, disorder status, and task type, making effects difficult to predict. Duncan (2006) posits that dual task “interference is worst when tasks make shared demands on similar processing systems,” highlighting the particularly high influence that task type may have depending on the systems it engages (p. 3).

Despite this ambiguity, some prominent themes in the relationships between dual tasking and speech fluency should be noted. First, speakers appear to experience some dual task interference, as even those with superior vocabulary, working memory, processing speed, and inhibition display fluency-related deficits when dual task demands increase (Kemper et al., 2010). However, the characteristics and level of those vulnerabilities often vary with age, disorder status and/or cognitive-linguistic ability (Kemper et al., 2011). Additionally, interference within dual task paradigms is often bidirectional, as performance on the simultaneous non-linguistic task may decrease as the complexity of the spoken language task increases (Kemper et al., 2011).

**Dual Tasks and Disordered Populations**

The presence, availability, and use of attentional resources are key for speakers when performing a dual task, and the nature of a communication disorder’s effects on these could mediate dual task effects on speech fluency and language. For example, aphasia may be seen more as a deficit in accessing linguistic functions and less of a loss in language function itself (Cahana-Amitay & Albert, 2015). This lends to the idea that variability in attentional demands
correlates with spoken language performance, as low demands allow for a higher rate of access to linguistic resources whereas high demands decrease the ability to access language. This approach to aphasia suggests that such a deficit in access to, not presence of, language causes people with aphasia to more rapidly exhibit an inability to match enough resources with needed demands, accurately and quickly evaluate demands, and direct resources accordingly (Cahana-Amitay & Albert, 2015). A simplistic interpretation of this framework could implicate a direct relationship between a dual task condition (designed to engage the attentional system) and disfluent behavior.

Although an aphasia-focused perspective may suggest that a dual task scenario will always induce difficulty, some studies on stuttering and typical speakers indicate otherwise, positing that such additional demands may play a more facilitative role in task performance. For example, Hartsuiker et al. (2005) propose that stuttering arises from excessive speech monitoring activity. Additionally, other studies show evidence that deliberate focus on motor control during a motor task often leads to performance decrease (Beilock et al., 2002; Wulf & Lewthwaite, 2010, as cited in Eichorn et al., 2016). A combination of these findings indicates that adding rather than subtracting certain demands to a speakers’ load in an effort to divert focus away from an overloaded attentional system could stimulate fluency. While Eichorn and colleagues found that less effort focused on speaking (as stimulated by another task diverting attention away from it) leads to more fluency (Eichorn et al., 2016), contradictory findings (Bosshardt, 1999; Oomen & Postma, 2001) make it difficult to determine how broadly this concept can be applied. Notable methodological differences exist between these dual task studies. For example, Eichorn et al. (2016) used monologues alongside working memory tasks and Bosshardt (1999) involved discrete word repetition with working memory tasks. Thus, individuals’ disorder status, the
nature of the speaking task, which additional demands are being introduced, and the extent to which the tasks are being manipulated must be considered.

**Age and Dual Tasks**

Compensatory strategies often differ between age groups when environmental demands are high during spoken language tasks. Kemper et al. (2005) suggest that when speaking while performing gross motor tasks such as walking or carrying heavy items and walking, older adults more quickly resort to alternating between one task and the other, whereas younger adults are more willing to continuously restrict their linguistic output in order to continue completing both tasks simultaneously. Kemper et al. (2010) paired fine motor and spoken language tasks and found breakdowns in speech fluency for both older and younger adults. However, while the breakdowns began to occur for younger adults immediately as dual task demands increased, older adults only exhibited linguistic breakdowns once demands surpassed a moderate level of difficulty. Apparently in an effort to minimize spoken language costs, older adults frequently utilized a slowed rate to compensate for increased demands, but when demands rose enough, breakdowns occurred in similar fashion to the younger group. Both studies show that older adults may be more willing to sacrifice one of the two tasks in order to perform one proficiently, while younger adults may unsuccessfully attempt to maintain proficiency in both, indicating differentials in preferred compensatory strategies but similar outcomes at the height of dual task demands.

**Psychological Stress and Time Pressure**

Psychological stress is another factor that may increase the demands present during communication. In addition to the dual task conditions discussed previously, the effects of psychological stress have been studied within disordered populations such as people who stutter
and people with aphasia. The hallmark symptoms of stuttering and non-fluent aphasias cause inherent stress in speaking even without the addition of external demands. While they do not share etiologies or core characteristics, both disorders represent a loss of control in maintaining a natural, uninterrupted flow of speech.

Various forms of externally induced stress are shown to impact speech fluency in people with aphasia and people who stutter. For example, participants with aphasia reduced their speech rate when retelling stories to unsupportive compared with supportive communication partners—a condition which they perceived as more stressful (Harmon et al., 2020)—and a modified Trier Social Stress Test induced increased state anxiety in people who stutter during a monologue task (Bauerly et al., 2019). However, evaluative observation caused little change in word retrieval during a naming task for James et al. (2018), suggesting that an assumption that any form of stress is an automatic catalyst for deficient cognitive, speech, or language functioning may be premature.

While many dual task forms have been studied in typical and disordered speakers, time pressure as a stress-inducing dual task is rarely mentioned in studies relevant to communication disorders. Time pressure in a discourse context can be conceptualized as a need to convey a message unusually quickly. Similar to a dual task, during time pressure speakers are required to attend to an extraneous environmental or social demand, which may divert attention away from speech and language processing. Given the various compensatory strategies often utilized by speakers involving sacrifice of one task for another when performing dual tasks (Kemper et al., 2005; Kemper et al., 2010), individuals could perform similar tradeoffs in response to time pressure.
Limited evidence in this realm provides some direction. One study found that errors increased and error-awareness decreased for typical speakers when they had less time to complete a picture naming and phoneme monitoring task (Ganushchak & Schiller, 2006). Another study using a more naturalistic monologue description task yielded increased repetitions under time pressure conditions, although error repair abilities did not change significantly (Oomen & Postma, 2001). These studies differ significantly in that Ganushchak and Schiller (2006) manipulated time pressure by providing participants with less time to respond to the stimulus, while Oomen and Postma (2001) had participants match their speech rate with a figure moving at a fluctuating rate on a computer screen. These two studies represent, to our knowledge, the only works on time pressure in a discourse context, and their contrasting methodologies further suggest the need for additional research on this subject.

**Purpose of the Study**

The purpose of this study is to examine the effects of dual task and time pressure conditions on the speech fluency of typical speakers. Based on previous research, time pressure may affect spoken language differently than traditional dual task conditions. A goal of the current study is to begin parsing out traditional dual tasks (in this case, a tone discrimination task) and time pressure as facilitators or inhibitors of speech fluency. Specifically, the current study aims to determine how time pressure, dual task, and combined conditions affect speech fluency and naturalness across groups of healthy adults segmented by age. We hypothesized that all three experimental conditions would decrease speech fluency and naturalness, but that the constellation of effects would differ by condition. Specifically, we hypothesized that compared to baseline, (a) speech rate would increase during time pressure (TP) and dual task (DT) plus time pressure (DT+TP) conditions but decrease during a DT condition, (b) pauses would increase
in all three conditions, but particularly in DT and DT+TP conditions, (c) disfluent behaviors (fillers, false starts, and repetitions) would increase in all three conditions, and (d) speech naturalness would decrease in all three conditions, but especially in TP and DT+TP conditions.

**Method**

**Participants**

Sixty healthy adults between the ages of 26 and 85 years participated in the study (see Table 1). To be included in the study, participants verified that they had no history of stroke, traumatic brain injury, or neurological damage and spoke English as their primary language. All data were collected at the Brigham Young University Aphasia Lab. Participants were recruited across three age groups, with 20 between 26 and 54 years (younger), 20 between 55 and 69 years (older), and 20 between 70 and 85 years (elderly). More participants were recruited between ages 55 and 85 than between ages 26 and 54 because of the changes in motor speech and linguistic processing that occur more rapidly as age progresses. Data collection continued only for participants who reported no history of stroke or other neurological disease by completing the Questionnaire for Verifying Stroke-Free Status with a score of 0. Participants’ selective and divided attention abilities were evaluated and described using Subtests 4, 6, and 7 of the Test of Everyday Attention (TEA; Robertson et al., 2001) because both selective and divided attention abilities are central to the experimental conditions used in the study. Participants also completed a basic hearing screening. All participants were given $15 in cash upon completion of the study.

**Instrumentation**

For each experimental condition, participants sat in a single wall sound booth to reduce potential acoustic interference and wore Sennheiser HD600 over-the-ear open-back headphones. To ensure that all audio equipment was in working order, that participants understood the task,
and to provide them with an opportunity to practice, they listened to and retold a short story similar in content and duration to the stories given during experimental conditions. Each participant’s speech was recorded by a boom microphone placed approximately 50 cm from the mouth. The acoustic signal was digitized with a Focusrite Scarlett 2i2 USB analog-to-digital converter at 44100 Hz and Adobe Audition (Version 22.0) software. The buttons participants pressed during each dual task were 2 inches in diameter, changed color when pressed, and were connected to the computer via USB.

**Procedures**

As part of a larger project, participants listened to and retold stories under baseline, dual task (DT), time pressure (TP), and combined DT + TP conditions. Experimental sessions for the entire project, which includes several conditions prior to those mentioned previously, lasted approximately one hour, and included eight story retell tasks under various background noise, dual task, and time pressure conditions. Each story spanned approximately 2-3 minutes. At the beginning of each condition, participants were asked, “Are you ready to listen to the next story?” Upon completion of the story, they were told “Thank you for listening. Please retell that story with as much detail as you can remember.” After each retell task, participants were then told “Thank you for retelling that story. Please fill out the rating form to tell me how you felt about retelling that story.” These rating forms included six statements querying participants’ perceptions about the task regarding feelings of effort (question #2), stress (questions #3-6), and overall communicative success (question #1), which were not analyzed as part of the current study.

During the retell task in each condition, the following stimuli were administered through the headphones: a timed condition (baseline), a time-pressure condition, a dual task condition,
and a dual task with time-pressure condition. These conditions were always administered following the conditions for the larger study and in the same order. Maintaining the order of this group of conditions was intended to create rising amounts of stress for the participants over time and thus simulate a stressful communicative exchange. The timed condition involved participants’ story retell being cut off at 30 seconds without warning. This condition created a naturalistic baseline to compare to other conditions. The abrupt cutoff of the participants was intended to stimulate communicative stress and thus impact the subsequent story retell. During the next condition, participants were told that they had 30 seconds to retell the story and that a bell would mark 15 seconds, 10 seconds, and 5 seconds remaining. During the dual task conditions, participants simultaneously retold the story and discriminated between high (2,000 Hz) and low (500 Hz) tones presented pseudo randomly with an average interstimulus interval of 6 seconds. Tone presentations lasted 250 ms. Participants were told to press a blue button when they heard a low tone and a red button when they heard a high tone. Before completing this task in conjunction with the story retell, participants practiced discriminating between the tones in isolation for approximately 1 minute. This ensured that participants understood the task and provided baseline measures of their response times in isolation. The tones were presented and the participants’ accuracy and response time was recorded using a MATLAB (Version 9.11) script. The first dual task condition was performed without presenting any additional concurrent stimuli during the retell, with participants asked to give equal attention to the tone discrimination task and retelling the story. The subsequent dual task with time pressure condition (DT+TP) combined the same dual task and time pressure stimuli from previous conditions, with the participants instructed to give equal attention to each task and retelling the story.
Dependent Variables

Story retell samples were recorded, orthographically transcribed verbatim, coded in the Codes for the Human Analysis of Transcripts (CHAT) format, and then analyzed using Computerized Language Analysis (CLAN) software (MacWhinney, 2000). CHAT coding involved segmentation of orthographic transcriptions into C-units (an independent clause alongside any related dependent clauses or modifiers) according to procedures given in Wright and Capilouto (2012). Trained research assistants further coded the segmented orthographic transcriptions for disfluencies such as fillers, false starts, and repetitions in CHAT format (MacWhinney, 2000). Additionally, Praat (Boersma, 2001) was used to code silent and filled pauses greater than 250 milliseconds (ms). These analyses were used to derive all dependent variables, which included the following measures: speech rate, extended pauses per utterance, fillers per verbalization, false starts and repetitions per verbalization, and speech naturalness (see Table 2).

Speech Rate

Speech rate was measured in words per minute (WPM). Analysis of speech rate was conducted on CHAT transcripts using CLAN software. The “timedur” function was used to calculate the number of words (excluding repetitions, false starts, or fillers) produced per minute.

Extended Pauses Per Utterance

Extended pauses per utterance was calculated as the number of pauses and filled pauses greater than 250 ms divided by the total number of utterances. All periods of silence greater than 250 ms or periods of silence greater than 250 ms that only include fillers were coded as extended or filled pauses. This time threshold was used based on previous research indicating that in individuals with no speech and language impairment, extended pauses are commonly defined as
periods of silence that are longer than 200-300 ms (Goldman-Eisler, 1968). Utterances were defined as C-units. Two individuals (the principal investigator and a trained research assistant) completed the analysis for this measure by following established, step by step instructions. High correlations were found from a sample of approximately 20% of all transcripts for both intra-rater reliability ($r = 0.96, r = 0.99$) and inter-rater reliability ($r = 0.99$).

**Fillers Per Verbalization**

Fillers were calculated by dividing the number of fillers by the number of verbalizations. Fillers were defined as any word or phrase that adds no meaning to the story retell (Marini et al., 2005), with verbalizations as any unit of verbal production, including meaningful words, fillers, false starts, and repetitions.

**False Starts and Repetitions Per Verbalization**

False starts and repetitions were calculated by dividing the total number of false starts and repetitions by the number of verbalizations. False starts were defined as any word left unfinished and repetitions were defined as any word or phrase that is repeated without linguistic intent (Marini et al., 2005).

**Speech Naturalness**

Speech naturalness, defined as natural or normal sounding speech, was rated on a 9-point Likert scale like the one used by Martin et al. (1984). The scale appeared in a computerized Qualtrics (Version March 2023) survey format and numbered in equal appearing intervals from 1 to 9, with 1 labeled as “highly natural” and 9 as “highly unnatural.” All audio samples were placed in randomized order and rated by three research assistants. Mean ratings across the three raters for each sample were used for analysis.
Data Analysis

Data were analyzed using two-way mixed-effects ANOVA with the group factor accounting for the younger, older, and elderly groups and the condition factor accounting for the baseline, TP, DT, and DT+TP conditions. Significant main or interaction effects were followed up using Tukey’s Honestly Significant Difference (HSD) test. Alpha was set at .05 for all statistical tests, with corrections made for follow up testing. Due to technical difficulties, data were not analyzed for one participant from the elderly group in the DT+TP condition and another participant from the elderly group in the DT condition.

Results

This study investigated the impacts of dual task and time pressure conditions on the speech fluency of neurotypical adults across three age groups. Overall, dual task, time pressure, and combined (DT+TP) conditions led to frequent changes in speech fluency compared with the baseline condition. Additionally, speech fluency was generally similar across group and condition combinations with the exception of differences in speech rate between the younger and elderly group in the DT+TP condition and differences in speech naturalness between younger and older groups and younger and elderly groups.

Speech Rate

A two-way mixed-effects ANOVA revealed an interaction effect for speech rate, $F(6,169) = 3.12, p = .006$ (see Figure 1). Follow-up testing showed that younger adults significantly increased their speech rate in the TP compared with the baseline condition ($t[169] = 7.095, p < .001$) as well as the DT+TP compared with the baseline condition ($t[169] = 3.93, p = .007$). Younger adults also increased their speech rate in the TP condition as compared with the DT condition ($t[169] = 5.84, p < .001$). Similarly, older adults significantly increased their
speech rate in the TP compared to the baseline condition ($t[169] = 5.61, p < .001$), in the DT+TP compared to the baseline condition ($t[169] = 4.79, p = .0002$), and in the TP compared to the DT condition ($t[169] = 3.65, p = .017$). In contrast, although like the other two groups, elderly adults significantly increased their speech rate in the TP compared to the baseline condition ($t[169] = 4.11, p = .003$), speech rate in the DT+TP and DT conditions was significantly slower than in the TP condition (DT+TP vs. TP: $t[169] = 4.44, p = .0009$; DT vs. TP: $t[169] = 4.06, p = .004$).

**Figure 1**

*Average Speech Rate for Three Groups Across Four Conditions*

![Graph showing average speech rate for three groups across four conditions.](image)

*Note.* Error bars illustrate standard error.
Extended Pauses Per Utterance

A two-way mixed effects ANOVA showed a main effect of condition for extended pauses per utterance, $F(3,169) = 15.25, p < .0001$ (see Figure 2). Follow-up testing showed that participants across conditions paused significantly more in the DT compared to both the DT+TP and TP conditions (DT vs. DT+TP: $t[169] = 3.3, p = .006$; DT vs. TP: $t[169] = 6.09, p < .0001$) and in the DT+TP compared to the TP condition ($t[169] = 2.77, p = .03$). Participants also paused significantly more in the baseline condition than in both DT+TP ($t[169] = 2.53, p = .05$) and TP conditions ($t[169] = 5.34, p < .0001$).

Figure 2

Average Extended Pauses Per Utterance Across Conditions

Note. Error bars illustrate standard error.
**Fillers Per Verbalization**

A two-way mixed effects ANOVA revealed a main effect of condition for fillers per verbalization, $F(3,169) = 6.14, p = .0005$ (see Figure 3). Follow-up testing showed that participants across groups used significantly more fillers in the DT+TP compared to the DT and TP conditions (DT+TP vs. DT: $t[169] = 2.83, p = .02$; DT+TP vs. TP: $t[169] = 4.03, p = .0005$). Participants also produced more fillers in the baseline than in the TP condition ($t[169] = 2.67, p = .04$).

**Figure 3**

*Average Fillers Per Verbalization Across Conditions*

![Fillers Per Verbalization](image)

*Note.* Error bars illustrate standard error.

**False Starts and Repetitions Per Verbalization**

A two-way mixed effects ANOVA revealed a main effect of condition for false starts and repetitions per verbalization, $F(3,169) = 6.26, p = .0005$ (see Figure 4). Follow-up testing
showed that participants across conditions used significantly more false starts and repetitions in the DT+TP compared to all other conditions: baseline ($t[169] = 3.49, p = .003$); DT ($t[169] = 3.07, p = .01$); and TP ($t[169] = 3.9, p = .0008$).

**Speech Naturalness**

A two-way mixed effects ANOVA revealed a main effect of group for speech naturalness, $F(3,57) = 11.42, p = .0001$ (see Figure 5). Follow-up testing showed that on a 9-point Likert scale and across conditions, younger participants’ speech was rated as significantly more natural than in the older group ($t[57] = 2.68, p = .02$) and the elderly group ($t[57] = 4.76, p < .0001$).

**Figure 4**

*Average False Starts and Repetitions Per Verbalization Across Conditions*

*Note.* Error bars illustrate standard error.
**Discussion**

A central purpose of this study was to examine the differential impacts of time pressure and other attentional demands on speech fluency. Time pressure may be characterized as both a social and attentional demand and—despite being identified as important in everyday communication (e.g., Harmon et al., 2020)—has received little attention within the field of communication disorders (Ganushchak & Schiller, 2006; Oomen & Postma, 2001). The dual task used in the study is more typical of divided attention tasks common in a large body of previous literature (e.g., Harmon et al., 2019; Murray et al., 1998; Sasisekaran & Donohue, 2016). Results from the present study indicate that time pressure affects fluency by increasing speech rate and that age impacts healthy adults’ ability to manipulate speech rate when compensating for combined attentional and social demands. Attentional demands may be a catalyst for fluent
speech when employed in small amounts, but when different demands are combined, interference in speech fluency increases. One explanation for this from resource-capacity models of attention could be that, by and large, the healthy adults who participated in this study had the attentional capacity and/or sufficient resource allocation to manage either the dual task or time pressure demand alone, but not both demands simultaneously (McNeil et al., 2004). In other words, the combination of these conditions may have caused the attentional demands to surpass the capacity and/or allocation thresholds for these participants. Additionally, variations in participants’ speaking behaviors confirm the relevance of categorizing types of disfluencies within both typical and disordered populations.

**Time Pressure Leads Adults to Speak Faster During Discourse**

Results related to speech rate indicate that typical speakers across age groups can either intentionally or subconsciously manipulate their rate in response to time pressure. It is possible that participants recognized that, in order to convey their message as they did during prior untimed conditions, they must speak more quickly. However, we did not analyze whether this increased rate of speech was correlated with decreased linguistic complexity. Even if linguistic complexity did suffer as speech rate increased, the lack of a condition effect for speech naturalness indicates that time pressure did not inherently diminish listeners’ perceptions of naturalness. Future research on the potential negative impacts of increased speech rate on overall communicative effectiveness may be relevant for both typical speakers and those with communication disorders.

The limited body of prior research on time pressure differs significantly in methodology and findings from the current study. Ganushchak and Schiller (2006) manipulated speaking conditions similarly, as participants were given less time to complete a spoken language task.
However, participants only completed picture naming and phoneme monitoring tasks, thus targeting microlinguistic production rather than fluency. Oomen and Postma (2001) utilized a picture description task with allowance for longer responses, but induced time pressure by asking participants to match their speech rate with a figure moving at a fluctuating rate on a computer screen. Ganushchak and Schiller (2006) found increased errors in phoneme monitoring under their time pressure condition, whereas Oomen and Postma (2001) found stable error detection and repair planning at faster speeds under time pressure. Thus, methodological differences in either the structure of the time pressure condition or the complexity of language being elicited can significantly impact findings. Maintenance of fluency measures in Oomen and Postma (2001) could be due to participants being provided with a dynamic visual model to follow, unlike participants in Ganushchak and Schiller (2006) who simply had less time to complete the task. Both studies vary enough methodologically from the current study that results are difficult to compare, but time pressure does appear to alter speech fluency to some extent.

Although not focused on time pressure, Buchanan et al. (2014) examined spoken language performance during a modified Trier Social Stress Test where participants prepared and delivered an alibi against a false accusation and then completed a mental arithmetic task, all in front of an observer. Results indicated that participants exhibited increases in both word productivity and extended pauses of 1 s or greater, potentially indicating how increased demands have the potential to facilitate some aspects of fluency and inhibit others. More specifically, participants who produced a larger cortisol and heart rate response showed especially heightened pause frequencies, suggesting that more pauses were the result of increased stress. No data were taken that could provide this much insight into the intent behind each pause in the current study, but the significant decrease in pausing when under time pressure could indicate that this
condition was less stressful than the one used in Buchanan et al. (2014). Therefore, the contrast between participants’ increase in pauses in Buchanan et al. (2014) and inverse results in the current study highlight the difference between a generally stressful speaking task centered around social confrontation and one that utilizes time pressure to induce stress.

**Age Influences How Adults Compensate for Additional Demands**

Findings regarding how elderly adults struggle to maintain their speech rate under the most demanding (DT+TP) condition compared to the time pressure condition corroborate those from previous research. For example, Kemper et al. (2010) used a similar dual task framework where participants completed a monologue speaking task alongside a simple rotor tracking task. Changes in older adults’ spoken language performance were found only when the rotor tracking task increased in difficulty, whereas younger adults adjusted their spoken language both when the rotor task was easier and when it became more difficult.

Although in the current study the heightening of attentional demands came through time pressure rather than through increasing the difficulty of the motor-based task, results also show distinctions in speech rate between age groups in the most demanding condition. One explanation for this is that elderly and young adults have different prioritization strategies. For example, perhaps because older adults are less likely to be concerned about making a good impression on others compared to younger adults (Cuddy et al., 2005) they might adhere less to speaking guidelines when attentional demands increase. Younger adults, on the other hand, may feel more concerned about following the given instructions.

Another explanation could relate to possible age-induced attentional deficits which lead to difficulty allocating attentional resources to both dual task and time pressure demands. Younger adults appear to be able to divide their attentional resources between both the dual task
and the time constraint, possibly due to better attentional capacity or allocation abilities compared to the elderly group. Attentional deficits could cause elderly adults to alternate less quickly and efficiently between each demand. Similarly, due to cognitive slowing, or age-induced reductions in processing speed (Salthouse, 1996), deficient attentional resource allocation may occur when attempting to complete speech and language planning for several utterances ahead while also completing a dual task. Future research on the impacts of dual tasking on macrolinguistic production for aging adults could further clarify what impact these attentional demands have on higher-order discourse planning and production.

**Attentional Demands Will Not Always Diminish Fluency**

Although speech fluency was affected differently by the most attentionally demanding condition across groups, the individual dual task and time pressure conditions led to some overall improvements in speech fluency. Eichorn et al. (2016) found that attentional demands decreased disfluencies (and particularly stuttering-like disfluencies) in both adults who stutter and fluent speakers, leading to a conclusion that speakers communicate most efficiently when attentional demands draw them away from the act of speaking just enough to allow for a more optimized distribution of cognitive and motoric resources. Results from the current study confirm this notion: compared to baseline, speakers were able to maintain their level of fluency and sometimes even significantly decreased disfluencies when either a dual task or time pressure was added. Like Eichorn et al. (2016) showed in their combined speaking and working memory task condition, talking while performing a tone discrimination task or when notified that limited time was allotted appear to streamline certain motoric and linguistic processes for healthy adult speakers rather than overload them.
Results specifically from the DT+TP condition, however, confirm that the addition of attentional demands can only maintain or facilitate fluency to an extent. While speakers decreased or maintained fillers and false starts and repetitions in time pressure and dual task conditions compared to baseline, the combination of these demands likely caused resources to be spread too thin for continued fluent production. Thus, although fluent speakers benefit from concurrent demands on their communication, these can grow too large to handle. Further research on whether and where such a threshold exists across various types of dual tasks or time pressure and different populations may be relevant in maximizing productivity of communication and any given concurrent task for typical or disordered speakers.

**Categorizations of Disfluency and Clinical Implications for Disordered Populations**

Each dependent variable analyzed in the current study is relevant to both typical speakers and those with communication disorders, but in markedly different ways. This can be captured by separating measures of speech fluency between motoric disfluencies—or interruptions of processes that involve motor speech components—and linguistic disfluencies—or interruptions in linguistic processing. False starts and repetitions may be viewed as motoric disfluencies and while present in typical speakers and those with various communication disorders, occur most prominently in individuals who stutter. Fillers and extended pauses could relate more to linguistic processes and can be viewed as “typical” disfluencies but can also occur frequently for people with communication disorders such as aphasia (Bailey et al., 2017; Nickels & Howard, 1995). Even so, extended pauses are often deliberately placed within utterances as markers of emphasis and can provide helpful prosodic variation in maximizing the impact of one’s message. Hence, increased pause frequency does not always correlate with communicative breakdown.
Similarly, speech rate is not so easily categorized. For an individual with a communication disorder, depending on the other disfluencies they exhibit, increases or decreases in speech rate may indicate either higher or lower levels of fluency. Thus, changes in speech rate may not be the mediator, but rather the result, of occurrences in disfluencies depending on speakers’ abilities to compensate for attentional demands. This can be especially true for individuals with aphasia, who experience linguistic breakdowns that often cause slow, effortful speech and report difficulty speaking under time pressure (Howe et al., 2008a, 2008b). Future research on the effects of time pressure may help to determine what role divided attention tasks hold in the assessment and treatment of aphasia.

Results related to false starts and repetitions from this study’s sample may also be relevant when compared to similar experiments with individuals who stutter. When completing a modified Trier Social Stress Test, adults who stutter experienced increased state anxiety compared to fluent control participants but did not produce significantly more disfluencies compared to baseline (Bauerly et al., 2019). In the current study, no significant change is noted in false starts and repetitions between baseline and time pressure. Similar to the prior comparison with Buchanan et al. (2014), this highlights the differential impact of a generally stressful condition and one built specifically around a time demand. The DT+TP condition appears to mark a shift from the threshold of facilitative over to detrimental divided attention. If this shift occurs for fluent speakers in the combined condition, speakers who stutter could experience detrimental effects at an earlier stage given their deficits in speech motor control. Future research on this topic could clarify whether time pressure elicits few changes in disfluencies for those who stutter like the task in Bauerly et al. (2019) did, or if it distinguishes itself as a catalyst for disfluency in this population.
Limitations

This study provides noteworthy insights into the influence of time pressure and dual tasking on speech fluency. Limitations of the study give impetus for future research. First, no data were presented on participants’ performance in the tone discrimination task completed during the dual task and DT+TP conditions. Such data would allow for analysis of bidirectional interference rather than considering only the impact of the dual task on spoken language.

Second, because this study utilized dependent variables related largely to speech fluency and less so to language, little inference can be made as to how linguistic characteristics such as complexity or productivity may have fluctuated across age groups and conditions. Thus, it is possible, for example, that significant decreases in fillers under time pressure compared to baseline may not inherently indicate increased overall communicative effectiveness alongside increased fluency, as participants may compensate well for the time pressure demand by reducing inefficient verbalizations but simultaneously communicate a message that is less linguistically coherent.

Third, no differentiation was made between silent pauses and filled pauses and thus no analysis was performed on separating “fluent” pauses from “disfluent” pauses. While this distinction would be difficult to make when analyzing language samples, it could be significant given that some pauses occur intentionally without being caused by disruptions in linguistic processing. Additionally, while the older and elderly groups were rated as having significantly less natural speech than the younger group, it should be considered that the research assistants who rated the samples were university students whose ages were closest to the range of the younger group. It is plausible that individuals may rate speech that sounds like their own as more natural than speech that seems to be associated with a more distant age.
Conclusion

This study found that time pressure, dual task, and combined (DT+TP) conditions resulted in differential effects on speech fluency in typical speakers across three age groups. Time pressure caused speech rate to increase across age groups but combining time pressure with a dual task condition mitigated this effect in elderly speakers. Participants performed similarly across age groups for fillers per verbalization, false starts and repetitions per verbalization, and extended pauses per utterance and did not always exhibit increases in these variables or changes in perceived naturalness as attentional demands increased. This highlights the possibility that attentional demands are not always inherently detrimental to fluency. Additionally, these findings suggest that increases or decreases in the occurrence of some of these variables may not always indicate corresponding fluctuations in fluency. Future research should continue investigating the effect of time pressure and other divided attention conditions on typical speakers and those with communication disorders to establish methods for optimizing conditions for effective communication in everyday situations.
References


### Tables

#### Table 1

*Mean (SD) of Group Demographic Information*

<table>
<thead>
<tr>
<th>Group</th>
<th>Sex (M:F)</th>
<th>Age (Years)</th>
<th>Education (Years)</th>
<th>QVSFS</th>
<th>TEA (VE1)</th>
<th>TEA (VE2)</th>
<th>TEA (TS)</th>
<th>TEA (TSC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger</td>
<td>9:11</td>
<td>38 (9)</td>
<td>17 (2)</td>
<td>0</td>
<td>11 (3)</td>
<td>10 (2)</td>
<td>10 (3)</td>
<td>11 (3)</td>
</tr>
<tr>
<td>(Ages 26-54)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older</td>
<td>10:10</td>
<td>61 (3)</td>
<td>16 (2)</td>
<td>0</td>
<td>10 (3)</td>
<td>10 (4)</td>
<td>10 (2)</td>
<td>10 (3)</td>
</tr>
<tr>
<td>(Ages 55-69)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elderly</td>
<td>10:10</td>
<td>75 (3)</td>
<td>16 (2)</td>
<td>0</td>
<td>11 (3)</td>
<td>9 (3)</td>
<td>9 (1)</td>
<td>10 (2)</td>
</tr>
<tr>
<td>(Ages 70-85)</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Note.* M = Male; F = Female; QVSFS = Questionnaire for Verifying Stroke-Free Status; TEA = Test of Everyday Attention (Robertson et al., 2001); VE1 = Visual Elevator Raw Accuracy; VE2 = Visual Elevator Timing; TS = Telephone Search; TSC = Telephone Search While Counting; TEA subtest scores reported are scaled scores.
### Table 2

**Dependent Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech Rate</td>
<td>Number of meaningful words per minute</td>
</tr>
<tr>
<td>Extended Pauses Per Utterance</td>
<td>Number of pauses or filled pauses longer than 250 ms per utterance</td>
</tr>
<tr>
<td>Fillers Per Verbalization</td>
<td>Number of fillers (e.g., “uh,” “um,” etc.) per verbalization (any unit of verbal production)</td>
</tr>
<tr>
<td>False Starts and Repetitions Per Verbalization</td>
<td>Number of false starts (unfinished words) and repetitions per verbalization (any unit of verbal production)</td>
</tr>
<tr>
<td>Speech Naturalness</td>
<td>On a 1-9 scale, how natural or normal each sample sounds to a listener</td>
</tr>
</tbody>
</table>
APPENDIX A

Annotated Bibliography


**Objective:** Examine changes in autonomic, behavioral, and acoustic measures in PWS compared to controls when taking a modified version of the TSST.

**Method:** Eleven AWS (seven M, four F, age 19-42, average age: 26) and 12 ANS participated in the study. Speaking tasks and physiological measurements were completed at baseline, pre-stress, and stress conditions. Tasks included a monologue under conditions designed to induce social stress as well as non-word reading tasks.

**Results and Conclusions:** Skin conductance and heart rate patterns (sympathetic nervous system measures) were similar between AWS and ANS, but respiratory sinus arrhythmia (parasympathetic measure) was higher for AWS, indicating that AWS enlisted more emotional regulation strategies but across both conditions. Speaking rates were significantly faster for AWS compared to ANS, but this also occurred across both conditions. This may be connected with initial reports of higher state anxiety in the AWS group.

**Relevance:** This suggests that disordered populations such as PWS who are at higher risk of emotional instability while communicating may demonstrate faster speaking rates in stressful situations. Multiple studies show that PWS generally slow their
rate compared to PNS, but it is noted that this could be due to task differences (ie reading vs spontaneous speech tasks).


**Objective:** What contextual factors within a two-person conversation involving two fluent adult speakers have influence on fluctuations in fluency?

**Method:** Forty-eight pairs of speakers discussed something familiar (matching photographs of children) and unfamiliar (solving tangrams, or geometric puzzles). Twenty-four pairs were married couples and 24 were male and female strangers. One individual in each pair was assigned as the “director” of one task, with the other as the director of the other task. Pairs were matched by age and age groups were broken into three: young, middle aged, and older. Disfluencies were marked as either fillers or repeats.

**Results and Conclusions:** Disfluencies sometimes increased when heavier cognitive demands were placed upon speakers. Fillers seemed to increase as speakers coordinated with their partners. Speakers’ disfluency rates were not much different when speaking with a spouse vs with a stranger. Older adults had slightly higher disfluency rates. The authors hypothesize that “speakers who try to take more care with their speech may succeed in producing more fluent utterances.”

**Relevance:** While our study is not examining patterns within discourse between communication partners, the idea that disfluencies increase under cognitive load confirms what we may see in our study. Will our participants’ speech become less fluent under the
more cognitively demanding tasks, or will this effect be offset by greater care for their speech under such conditions?


**Summary:** This chapter outlines components of attention divided into basic and complex groups, with sustained attention, vigilance, and arousal falling into the former category and selective, focused, alternating, and divided attention in the latter. The authors discuss the ambiguous interconnectivity of linguistic and attentional processes, particularly for people with aphasia, and how dual task paradigms tend to decrease spoken language performance.


**Objective:** (a) What factors best predict how a speaker perceives spontaneity? (b) What factors best predict how a speaker perceives fluency? (c) How well do perceived spontaneity and perceived fluency predict adverse life impact of stuttering (pg. 986)?

**Method:** Forty-four participants (20 F, 24 M, Age 21-71, Mean age 36) who identified as people who stutter by either at least very mild severity score on the SSI or mild rating on the OASES filled out five surveys per day for one week. The surveys measured the participants' most recent conversation and included questions about the speaking context as well as fluency and spontaneity.

**Results and Conclusions:** Spontaneity appeared to have a significant negative correlation with adverse life impact, while fluency did not have any significant
correlation with adverse life impact. Spontaneity increased when speakers had conversed about their stuttering with the conversation partner or with family and when they felt higher self-efficacy. The authors concluded that spontaneity and fluency are constructs that affect PWS’ experience much differently and thus should be evaluated differently.

**Relevance:** If time pressure induces some of the opposite effects created when individuals speak more spontaneously, speech may become more of an effortful experience, even if fluency is relatively unaffected. While this study investigates a disordered population in contrast to our typical participant pool, it may be important to consider this as an influence on potential results involving little changes in fluency under TP and DT conditions.


**Objective:** How does the stuttering frequency of people who stutter change when given immediate feedback when they stutter?

**Method:** Five male and three female individuals who stutter spoke spontaneously with under conditions of no feedback, feedback each time they stuttered, and feedback plus a 5 cent payout each time they stuttered.

**Results and Conclusions:** No significant changes were found between conditions in terms of changes in stuttering frequency.

**Relevance:** The results of this study may not be relevant to ours, given that their sample size is quite small. However, it is important to consider that some speakers may
not react to feedback (ie – some participants’ subsequent retells following the first timed condition may contradict our expectations and not be altered by the abrupt cutoff).


**Objective:** How does engagement of working memory affect speech fluency within a dual task paradigm?

**Method:** Nineteen AWS and 20 ANS participated. They provided a 60 second monologue (answering a basic question such as “describe a recent vacation”) and performed a simple working memory addition task in isolation and as a dual task.

**Results and Conclusions:** Dual task conditions increased fluency for both AWS and ANS, but specifically with atypical disfluencies. Both groups reduced their speech rate, but AWS showed a smaller reduction, and the apparent relationship between fluency and rate appears to only apply to atypical disfluencies. "Speech production is ideally managed by implicit, rather than explicit, modes of control...[and] speech production, like skilled motor performance across a variety of tasks, benefits from minimized attentional control and maximized automatization” (p. 426).

**Relevance:** The “less is more” idea seems to apply to the allocation of attentional resources to speech motor control within a working memory dual task paradigm. We could see similar results in our dual task condition because it also engages working memory, but our introduction of time pressure may stimulate different behaviors due to its nature as a dual task focused on rather than being adjacent to the speech/language.

**Objective:** How do adults who stutters’ speech and autonomic responses change when under various demands in comparison to the same results in adults who do not stutter?

**Method:** Eight adults who stutter and eight adults who do not stutter participated. Under each condition, the tasks involved finishing a phrase begun by the researcher but with either linguistic, memory, or social demands.

**Results and Conclusions:** Tongue advancement was similar between groups in terms of temporal variability, but AWS showed more variability in the extent of tongue advancement. No significant differences were noted in acoustic measures between conditions for each participant. Autonomic responses were quite similar between groups, but AWS had larger standard deviation values. State and trait anxiety, communication apprehension, and communication attitudes were found to be somewhat related.

**Relevance:** Similar to Corcoran (1980)’s findings, this suggests that placing various demands on speakers may not elicit significant impact. However, the conditions of this task are quite different than in our study, where they only had participants saying short sentences at most, whereas we have participants providing multiple monologues of 1-2 minutes.


https://doi.org/10.1016/j.brainres.2006.09.096
Objective: As measured by event-related potentials in the brain, how do individuals react to their own errors in phoneme monitoring and how do those errors change as time pressure increases?

Method: Subjects participated in a phoneme monitoring task in which they named pictures and pressed a button when a given target phoneme was in the picture name. Three conditions – control, time pressure 1, and time pressure 2 – with the time given to provide the picture name decreased from the control down to the 2nd time pressure condition.

Results and Conclusions: As time pressure increased, phoneme monitoring errors increased as well. Part of this was deemed to be due to decreased amplitude of error related negativity (ERN) during time pressure conditions – equating to less awareness of errors -- which caused more errors to be made.

Relevance: While the tasks in this study are much different than the tasks in ours, we could say that these results support our hypothesis that speech and language performance may decrease under our time pressure condition. The results related to ERN also indicate that as time pressure increases, our participants may become less aware of their errors, spend less time correcting them, and/or commit more errors as a result.

**Objective:** How does a dual task affect content accuracy, delivery speed, and perceived effort as well as reported feelings about communication for people with aphasia compared to controls?

**Method:** Study #1: 33 participants; 21 with brain injury and 12 without brain injury. Participants were presented with short stories which they then retold in non-dual task and dual task conditions. The dual task condition involved discrimination between high and low tones. Dependent variables were self-rated perceived effort and quantitative story retell performance. Study #2: After study 1 was completed, participants answered questions in a semi-structured interview about their overall experience and more specifically about each condition. People with aphasia were provided appropriate accommodations to meet their communicative needs.

**Results and Conclusions:** Study #1: Controls sacrificed speed instead of accuracy, as they slowed down but maintained accuracy during the experimental condition. Participants with mild aphasia slowed down even more while somewhat maintaining accuracy. The moderate aphasia group decreased accuracy significantly but lost very little speed. This could be because this group was already speaking at a reduced rate during the baseline condition or because memory and attentional deficits create difficulties with regulating speech rate. The mild aphasia group reported significantly higher perceived effort than controls, but the moderate aphasia group did not. Study #2: Marked differences were observed between PWA’s attitudes about the dual task and the attitudes of the controls. PWA expressed that the dual task caused frustration, stress, and irritability along with a lack of concentration. They internalized these feelings in ways that indicated low communicative self-efficacy and withdrawal in real-life situations.
Ratings of perceived effort increased for both groups, but this coincided with a greater
degree of decreased performance for the PWA group.

**Relevance:** This somewhat reflects the differences seen between age groups in
other studies, with one group establishing a slower rate during baseline conditions and
then maintaining that slower rate during the dual task. In the current study, it will be
useful to similarly examine the correlation between reported effort and measures of
performance.

communication partner affects story retell in aphasia: Quantitative and qualitative
https://doi.org/10.1044/2019_AJSLP-19-0091

**Objective:** Study 1: How does the responsiveness of a communication partner affect
measures of content accuracy and delivery speed in the spoken language of PWA? Study
#2: How do PWA and controls describe their experience communicating with responsive
vs. unresponsive partners?

**Method:** Study #1: 21 PWA and 12 controls participated in the study. They
listened to stories paired with pictures and then retold each story separately immediately
afterward to either a supportive or an unsupportive communication partner. Study #2:
The same participants from study #1 completed a semi-structured interview immediately
following the story retell tasks about their experience with the two conditions.

**Results and Conclusions:** Study #1: All participants reported feeling more
psychological stress when retelling to the unsupportive partner, with the PWA group only
showing slightly higher levels of stress. Delivery speed also decreased for all participants
in this condition. Study #2: PWA talked more than controls about the unresponsive partner’s behaviors and expressed stronger emotions about communicating during that condition. Both groups described distinct differences in their experiences between conditions, but the PWA group described more negative emotions during the unsupportive condition than controls. PWA highlighted their frustrations with the unsupportive partners, while controls highlighted the supportive behaviors given by the supportive partners. While study #1 showed little difference between psychological stress levels of each group, study #2 showed marked differences in the communicative experiences between groups. This may be due to the more expansive nature of semi-structured interviews (i.e., participants are able to express themselves beyond a rating of a single psychological state).

Relevance: Data taken from self-rating scales may not reflect an accurate measure of emotional/psychological load. This will be important to consider when analyzing data from the current study, as qualitative interviews will not be used to compare with the rating forms. The stress response elicited in this study somewhat related to the stress response elicited in the time pressure condition of the current study.


Objective: How does speech vary within and between utterances for adults who do and do not stutter when placed under social-cognitive stress?
**Method:** Twenty-four adults who stutter (AWS) and 21 adults who do not stutter (AWNS) participated. AWS were identified using the OASES and SSI-4. Participants repeated sentences presented on a screen under conditions with unfamiliar observers either being present or not present. Observers scribbled on a pad and coughed audibly while in the room in order to stimulate social-cognitive stress.

**Results and Conclusions:** The AWS showed more acoustic across-sentence variability than AWNS. Within sentences, the AWS’s speech was more deterministic and stable than AWNS. Presence of observers increased within sentence determinism and stability in AWS but didn’t impact across-sentence variability.

**Relevance:** The idea that social-cognitive stress influences fluency in adults who stutter could carry over to the time pressure conditions in our study: as participants are alarmed by the abrupt cutoff in the no-warning timed condition, will their subsequent retells reflect increased perception of the researcher’s expectations for their speech/linguistic output?


**Objective:** Does a condition of being observed and evaluated cause difficulty in word retrieval, and specifically increase the likelihood of tip-of-the-tongue (TOT) states?

**Method:** All participants were undergraduate students, made up of 60 women and 18 men. They each completed the Trier Social Stress Test followed by a naming task with either evaluative observation (TSST group) or no evaluative observation (pTSST group). Evaluative observation spanned throughout the TSST and the naming task.
Results and Conclusions: There was a difference between the number of TOT’s in the TTST group and the pTSST group, but that difference was not significant. Pilot studies done with the evaluative observation occurring during either TSST or the naming tasks rather than during both did not show an increase in TOT’s. The authors concluded that while TOT’s can increase under evaluative observation, they are not caused as easily by that observation as we may think.

Relevance: Our study does not deliberately incorporate components of evaluative observation as an independent variable, but the time pressure condition potentially could provide a similar effect in a small way as the TSST. However, as this study indicates that the evaluative observation has to be quite high in order to induce high TOT’s, it seems unlikely that our study would provide that. While participants are likely to exhibit extended pauses and other suprasegmental markers of TOT’s, it would be difficult to determine if TOT’s were actually occurring.


Objective: How does divided attention impact linguistic measures in spoken language production?

Method: Fifty-two typical speakers participated, half in a full-attention and half in a divided-attention condition. For the spoken language task, they recalled information presented immediately prior, and for the dual task they simultaneously performed simple math equations.
**Results and Conclusions:** In the divided attention condition, participants’ linguistic output was significantly less meaningful at micro and macro levels, including an increase in overall pauses and within-clause pauses.

**Relevance:** While we are examining speech fluency measures rather than linguistic measures, these results can inform us in our measure of extended pauses, which can serve as both a speech fluency and linguistic productivity measure. While our preliminary results have not shown significant changes in extended pauses between conditions, this could change when we analyze older age groups’ data, or participants may alter their linguistic productivity in ways other than pausing which we are not currently analyzing.


**Objective:** When given a variety of somewhat physically demanding tasks, how is linguistic content affected between younger and older adult groups?

**Method:** Twenty-six young adults and 37 older adults participated in the study. Participants engaged in five tasks: talking alone, walking alone, walking while talking, walking and talking while carrying a 10 pound bag of groceries, and walking and talking while climbing steps (done in random order). Time when they were walking and talking simultaneously was marked as “time on task.” Language samples were elicited by asking them about people or events significant to them, vacations, notable inventions, or people they admire (all questions were shown to them on cards). Language data was analyzed for verbal fluency, grammatical complexity, and linguistic content.
**Results and Conclusions:** Young adults compensated for dual task demands by restricting their speech register (using shorter and simpler sentences), similar to the older adults’ baseline speech register. Each component measured faltered as DT conditions increased for the younger adults. Older adults initially walked and spoke more slowly under the DT condition, and as that condition added more demands, fluency decreased as well. While eventually they would sometimes alternate between walking and talking when demands were high, their grammatical complexity and content did not falter. This contributes to evidence displaying a “function floor” for grammatical complexity and linguistic content, or minimum performance levels that older adults do not descend below regardless of task.

**Relevance:** The discussion in this study focused primarily on effects of the tasks on the older adult group. Results further reinforce the idea that young and older adults employ quite different measures to compensate for dual task demands. The “function floor” concept is something to watch for in our current study—will our participants in the older age groups display language output that decreases in quality to a certain extent, but holds fast once DT conditions reach a certain point (i.e., Could performance decrease under background noise, and more so under DT conditions, but not decrease further under DT-time condition)?

https://doi.org/10.1080/13825585.2010.527317
Objective: How is rotor tracking ability predicted by utterance duration and sentence-level grammatical complexity for groups differing in age and various measures of cognitive ability? Three primary questions were asked: Is speech planning costly? Is speech production costly? Is speech output costly?

Method: Eighty people participated in the study and were primarily grouped by age (younger vs. older adults). They completed a 4 minute rotor tracking task to establish a baseline. During the dual task, they spent 1 minute tracking the rotor; then the question “please describe someone you admire or someone who has influenced your life” appeared on the screen, which they responded to for 3 minutes while still tracking the rotor.

Results and Conclusions: Results focused on within-participant differences between utterances in reference to the questions listed above. For question #1: Is speech planning costly? tracking performance suffered when participants neared a relatively complex/dense utterance. Older adults were less prone to suffer great decreases in performance, possibly due to their linguistic baseline already being relatively being simplified. For question #2: Is speech production costly? performance declined under not only one but three linguistic conditions—many words in an utterance, denser utterances, and more complex sentences. These effects increased for those with relatively low working memory capacity/slower processing speeds. Older adults also showed more decline here, as these linguistic conditions are less common for them given their tendency to remain using simplified speech. For question #3: Is speech output costly? linguistic conditions that made tracking difficult included utterances with many words, longer utterances, and rapid utterances, indicating a need to recover from recently producing linguistically demanding speech. Older adults struggled with this more for similar reasons
as previously described (as difficult utterances are not their “norm,” it is costly for them to increase difficulty in most linguistic categories.

**Relevance:** It may be helpful to measure participants’ performance on the tone discrimination task according to particular points during each retell (for example, does response time differ between the beginning and end of the retell?).


**Objective:** Given that older and younger adults show differences in vocabulary, processing speed, working memory, and inhibition, how do those factors correlate with the likelihood that one will struggle to simultaneously produce sufficiently complex speech and accurately perform a cognitively demanding task?

**Method:** One hundred young adults and 97 older adults participated in the study. Control data was obtained through separate pursuit rotor tracking and speech production tasks. Speech samples were elicited by asking participants to give their opinions on advantages and disadvantages of living in their current city or on historical events. The experimental condition involved two dual tasks: one where participants talked while tracking a rotor moving at the same speed as the baseline rotor, and one where participants talked while tracking the rotor moving at a 50% faster speed than the baseline. Data collection for the rotor task focused on the participants’ time-on-target and average distance from target when off-target. Language data was analyzed for verbal fluency, grammatical complexity, and linguistic content.
**Results and Conclusions:** Rotor tracking became more difficult for both age groups during the dual task but was not significantly more difficult for one age group than the other. As the dual task became more difficult, young adults spoke with less fluency, less complexity, and were less informative. The same was true for older adults except that linguistic components did not suffer until dual task demands surpassed the ‘moderate’ condition. Older adults also more frequently slowed down in order to minimize other linguistic costs, which may be why linguistic components did not break down for them as easily. Even for those with superior vocabulary, working memory, processing speed, and inhibition, speech was vulnerable when the dual task became more difficult.

**Relevance:** This study indicates that while younger and older adults do attempt to linguistically compensate for dual task demands in different ways, both groups’ linguistic output is vulnerable to these demands—to the extent that their output provides little substance or flow. This finding can guide our analyses of linguistic content when examining the differences in results between age groups.


**Objective:** What is the state of the literature on speech naturalness in terms of how it is measured and defined in comparison to other aspects of speech?

**Method:** Sixty-three articles published between 1990-2014 were reviewed, with over half focused on stuttering, 16% on motor speech disorders, and a few others in various other subfields of SLP.
**Results and Conclusions:** Most studies used a 9-point Likert scale, with 9 indicating highly unnatural and 1 as highly natural. An important discussion was whether studies correlated naturalness with other speech measures such as rate, sentence/word/phrase duration, frequency, etc. and whether inter-rater reliability measures were reported. Many studies did not provide a definition of naturalness and several used a simple definition like “natural or normal speech.” The authors conclude that the studies are very difficult to compare due to differences between them across multiple realms.

**Relevance:** Using a speech naturalness rating in our study may be less complicated given that we are not studying a disordered population and thus are not asking raters to incorporate understandings of atypical speech. Therefore, a 9-point Likert scale and a simple definition of “natural or normal sounding speech” may be sufficient for our purposes.


**Objective:** Do PWA trade performance between a story retell task and a visual-manual tracking task in a dual task setting, and are these tasks effective in aphasia assessment?

**Method:** Twenty neurotypical individuals listened to and retold stories given by normal and aphasic individuals from mild-severe and tracked a line moving across a computer screen with a joystick with varying degrees of difficulty, both in single and dual task conditions.
**Results and Conclusions:** Story retell difficulty (as modulated by aphasia severity) effected tracking performance, but tracking difficulty did not affect story retell performance. The authors suggest that the visuomotor task may have not been difficult enough to stimulate difficulty with the story retell.

**Relevance:** When participants are not affected as we expect by the DT condition, it will be important to consider that they may still be vulnerable to DT effects, but the condition could have not been strong enough to stimulate those performance declines.


**Objective:** How do tasks performed while speaking affect spoken language for typical and aphasic speakers?

**Method:** Eight control and 14 aphasic individuals participated in the study. Nearly all aphasic participants had anomic or conduction aphasia. They completed a picture description task and a tone-discrimination task with variations in which tasks to prioritize.

**Results and Conclusions:** Morphosyntactic, lexical, and pragmatic aspects of their spoken language were impacted by the addition of dual task demands. Differences between typical and aphasic speakers were as expected, but under the more demanding conditions, those differences increased – the control group experienced very little linguistic costs as demands increased, but the aphasic group experienced significant costs. The aphasic group also performed more poorly on the tone discrimination task
during dual task conditions while controls’ performance was consistent between each condition.

Relevance: These results give us cause to wonder if our control group may not experience many linguistic costs under dual task conditions. However, our insertion of a time-pressure condition may differentiate our study’s results from this one. An interesting comparison can be made between this study and the Kemper et al. ones.


Objective: How do children and adults compensate for dual task demands as shown by their encoding and monitoring of phonemes?

Method: Twenty children in two age groups (7-11; 12-15) and 10 mostly younger adults participated in the study. The dual task involved picture naming and phoneme monitoring within the picture name along with temporal tone discrimination.

Results and Conclusions: Results indicated a significant correlation between phoneme monitoring errors and percentage of disfluencies in the child age group.

Relevance: While a phoneme monitoring task has significant linguistic differences compared to our time pressure and dual task, the conclusion that errors in one speech/language domain can lead to or be correlated with errors in another domain suggests potential for similar correlations between variables in our study.

Objective: Explains the application of the demands and capacities model in relation to stuttering treatment in young children.

Method: N/A, as the article does not describe an experimental study.

Results and Conclusions: Decreasing environmental demands and increasing capacity to deal with those demands increases speech fluency in children.

Relevance: While this article focuses solely on the demands and capacities model related to childhood stuttering, it can still be applied to the current study. Similar to the point made by the authors that the fluency of children who stutter may fluctuate according to environmental demands and their cognitive, linguistic, and motor capacities, we believe that non-stuttering-like disfluencies may increase under the more demanding story retell conditions. Additionally, it will be important to observe indicators of the capacity of individuals according to age group.


Objective: In older and younger adults, how do age and/or Parkinson’s disease (PD) predict performance within a dual task paradigm? It is assumed that for most healthy adults, the addition of a dual task has at most a minimal impact on the performance of a previously learned motor skill. So, if/when do age and Parkinson’s disease stimulate higher effortfulness in performing these tasks and/or decreases in task performance?

Method: Forty-five individuals split between older, younger, and Parkinsonian adult groups participated in the study. All participants with PD exhibited either
hypoactive or mixed hypoactive-hypoactive dysarthria. Each participants engaged 12 times in a task of saying six nonwords as quickly as possible for 30 seconds. On the next day, participants completed the same task again in isolation along with completion of the dual task. The additional visuomotor task involved tracking a target in circular motion with a computer mouse, which participants practiced in isolation between five to 15 times prior to the dual task trials. During the dual task, participants engaged in both tasks simultaneously for three 30-second periods. The goals of the tasks were for participants to speak as quickly and accurately as possible for the speech portion and to track the target with the mouse as accurately as possible for the visuomotor task.

**Results and Conclusions:** Results indicated that the younger adults experienced very little interference for the nonword production task during the dual task. However, the older control group experienced intermediate interference and the PD group experienced even more interference during the dual task for both the visuomotor and nonword production tasks. Younger adults from the single to dual tasks revealed almost no differences in speed or accuracy with no outliers. Older controls’ performance in the dual task was more variable, with some participants exhibiting similar accuracy and speed as the younger group while others experienced substantial interference. Results from the PD group did not yield any performances close to the younger group, as all participants exhibited significant dual task costs. Findings for the younger adult group corroborated the authors’ expectations that this population’s speech or motor performance would not be impacted by a dual task paradigm. Findings for older controls tentatively confirmed expectations that they would experience interference, with the caveat that they may have not experienced the same level of interference had they been
given more time to practice the tasks before performing them simultaneously. While the authors were unable to determine exactly where interference occurred for the PD group, findings indicated that this population may be deficient in transferring motor skills from being effortful to automatic.

**Relevance:** If our DT is relatively similar in its effects on participants as theirs was in this study, we may see a similar lack of interference for our younger group and even most of our older group. But findings here imply that our expectation of different findings in future studies of disordered populations using our DT/TP paradigm may be correct.
APPENDIX B

Consent Form

Consent to be a Research Subject

Title of Research Study: Measuring the Effects of Distracting Contexts on Language Production: Normative Data for Use in Aphasia Assessment

Principle Investigator: Dr. Tyson Harmon, Ph.D., CCC-SLP IRB ID#: IRB2021-289

Introduction

This research study is being conducted by Tyson Harmon, Ph.D., CCC-SLP at Brigham Young University. The purposes of this study are to (1) measure the impact of attentionally demanding conditions on spoken language and (2) create a collection of data from typical speakers to help in the assessment and treatment of language in people with aphasia. You were invited to participate in this study as a pilot or control participant.

Procedures

Your participation in this study will involve a single session lasting 1 to 1.5 hours. During the session, you will be asked to complete an attention test. You will also complete a questionnaire intended to verify that you have not experienced a stroke or other neurological damage.

During the experimental task, you will listen to a variety of short stories and retell them in attentionally demanding conditions. This session will be held on Brigham Young University (BYU) campus (John Taylor Building room 106).

Audio/video Recordings

During the session, audio and video recordings will be obtained throughout the research session. Your consent below allows (BYU) to use these recordings for purposes associated with the Study:

I understand that researchers will take audio and video recordings of me as part of this Study. These recordings will include either audio only or both audio and visual information, which may allow me to be identifiable to viewers. I give permission for BYU to use the Media in scientific publications, scientific conferences or meetings, educational presentations, public presentations to non-scientific groups, and other uses related to the Study so long as my name is not used. I agree that all Media will become the property of BYU, and I waive my right to inspect, approve, or be compensated for BYU’s use of the Media.
By signing below, I certify that I have read this Consent to Use Video Recording and agree to its terms. Name of Participant: ______________________________________  

(Please Print)  

Signature: ____________________________ Date ________________

IRB NUMBER: IRB2021-289  
IRB APPROVAL DATE: 10/29/2021 IRB EXPIRATION DATE: 10/28/2022

Risks/Discomforts

Risks associated with this study are minimal. Because some of the tasks may be difficult, you may become anxious or embarrassed. You might also become tired or frustrated. We will make every effort to be sure you are as comfortable as possible during the testing. You can take a break or discontinue your participation at any time. If the session is too long, the length and number of sessions can be changed according to your needs.

Benefits

Although there will likely be no direct benefit to you for participating in this study, your participation will provide us with information that might generally improve assessment and treatment of people with aphasia.

Confidentiality

All data collected for the purposes of this study will be kept confidential and will only be reported without personally identifiable information. Any personally identifiable information will be stored separate from research data in a locked cabinet in the researcher’s office. As stated previously, if audio or video clips are used for any purpose associated with the study, your name will not be used.

You will be given a number that will identify you for this study. All data obtained from you will be associated with this number instead of your personally identifiable information. Any paper forms or test protocols will be kept in locked cabinets in a locked research lab at BYU. Any electronic forms or files (e.g., audio/video files) will be kept indefinitely on a secured, password protected server. Only those directly involved with the research will have access to these data.

Data Sharing

We will keep the information we collect about you during this research study for analysis and for potential use in future research projects. Your name and other information that can directly identify you will be stored securely and separately from the rest of the research information we collect from you.
De-identified data from this study may be shared with the research community, with journals in which study results are published, and with databases and data repositories used for research. We will remove or code any personal information that could directly identify you before the study data are shared. Despite these measures, we cannot guarantee anonymity of your personal data.

The results of this study could be shared in articles and presentations, but will not include any information that identifies you unless you give permission for use of information that identifies you in articles and presentations.

**Compensation**

You will receive $15.00 cash after completing the session.

**Participation**

Participation in this research study is voluntary. You have the right to withdraw at any time or refuse to participate entirely.

**Questions about the Research**

If you have questions regarding this study, you may contact Tyson Harmon, Ph.D., CCC-SLP by phone at 801-422-1251 or email at tyson_harmon@byu.edu.

**Questions about Your Rights as Research Participants**

If you have questions regarding your rights as a research participant contact Human Research Protection Program at (801) 422-1461; byu.hrpp@byu.edu.

**Statement of Consent**

I have read, understood, and received a copy of the above consent and desire of my own free will to participate in this study.

Name (Printed): _______________ Signature: ____________________ Date: _____________
APPENDIX C

Training Protocol for Codes for Human Analysis of Transcripts System

Phonological Analysis:

False Starts: [&]

- When the word is not finished (the word is left unfinished). Note: Listening to the audio files with headphone/earbuds helps with hearing false starts that aren’t heard using the computer speaker.
  - Example: I &wa went to the store.

Phonological Paraphasias: [* p]

- The substitution of a word with another word or non-word that preserves at least half of the segments and/or number of syllables of the intended word
  - Example: The mice wanted to <heat> [* p]
  - Note: do not code common colloquial versions of a word (ex: ‘gonna’ for ‘going to’, ‘cause’ for ‘because’)

Neologisms: [* n]

- A substitution of a word for a gibberish word
  - Example: she had all her gaestidʒuz@u [* n] ← (add @u to error)

Lexical Analysis:

Lexical Fillers: [* fil]

- When a word or phrase adds no meaning to the story.
  - Example: <well> [* fil] the mouse family decided to go on a picnic
  - Example: the mouse ran <I think> [* fil] into the forest *
  - Example: <It look like>[* fil] the mouse is running into the forest.
    - *Note: Do not count “I think/I believe/I feel etc for expository discourse (DrivingLang, NoiseLang)
    - Ok so in the beginning is not a fil

Repetitions [/]

- When a word or phrase is repeated
  - Example: He felt a <little> [/] little scared
Example: **<He felt> [/] he felt** a little scared

- **Note:** do not code repetitions if the participant is using repetition as a rhetorical device and you can tell they meant to do it, such as the house was really really big when describing a massive house. Often the person who transcribes the discourse will go ahead and mark these as repetitions so be on the lookout for this and change if necessary. (ex: he ran and he ran and he ran all the way down the tunnel)

**Rephrase/Revision [/]**

- When a sentence or phrase is rephrased or restructured.
  - This could be syntactic-Example: **<he felt a little> [/] the boy feels scared**
  - It could also be semantic-Example: a family of **<rats no> [/] mice.**
  - Note- the person who does the transcription will often go ahead and put the rephrasals in as they transcribe but sometimes they don’t so if something looks like it needs to be a rephrasal to make sense, go ahead and code it.

**Semantic Paraphasias [* s:r]*

- The substitution of a word on the basis of a meaning between the two words
  - Example: The mice got into the **<van> [: truck][* s:r]**
  - Also, in story retell tasks, we have been coding incorrect names as a semantic paraphasia. **<Bob> [* s:r] went to the baseball game.** (instead of George)

- **Note:** sometimes there can be a question of whether a misused word should count as a semantic paraphasia or a semantically anomalous utterance. If you feel that the participant simply used the wrong word but understands what’s going on in the story, code it as a semantic paraphasia. If you think the participant has misinterpreted what’s going on in the story, code it as semantically anomalous (ex: the many people who think that the dog in ‘flowerpot’ Is an elephant)

**Passe-partout words [* ppw]*

- The substitution of a word for a general referent (*something, someone, somehow*)
  - Example: There is **<something> [* ppw]** on the table. (Couldn’t remember word for book potentially, just depends on context.)
We won’t use this code every time we see something, someone, or somehow. This code is used when there is a clear substitution of the more specific referent.

Grammatical and Morpho-syntactical Analysis:

**Substitution of Function Words (Closed Class Words) [* f]**

- When a function word is changed for another function word. (e.g. he, she, it, in, on, the, a, etc.)
- This includes the incorrect use of pronouns, which is common in the aphasia files.
  - Example: I went <on> [* f] the circus. (should’ve said to)
  - Example: <He> [* f] talked to the manager. (when talking about a woman)

**Substitution of Bound Morphemes: [* m]**

- Typically the incorrect tense or plurality. Basically, any grammatical error will be coded as [* m]
  - Example: They will <eats> [* m] the sandwiches and cupcakes.
  - Example: The <mice> [* m] fell out of the truck.
  - Example: They had a <trucks> [* m]

**Omission of Function Words (Closed Class Words) [* ofw]**

- The missing of a closed class word (e.g. he, she, it, in, on, the, a, etc.)
  - Example: 0[* ofw] cat ran down [* ofw] hallway

**Content Omission [* oc]**

- The missing of any content.
- If the person ends a sentence or phrase after the verb, we code it as an aposiopesis and content omission
  - Example: [* oc] ran into the attic. ← We need to know what ran into the attic
  - Example: I hate +... [* ap][* oc]. ← We need to know what they hate

**Paragrammatism [* pg]**

- Errors where organization of words is unnatural, but there are not any specific grammatical errors.
- Could also be used if the error doesn’t fit into an existing category
  - Example: <lonely is the grandma> [* pg]
Example: there was a lady who was a gray-haired <lady older> [* pg]

Marco-Linguistic Analysis:

Wrong use of Cohesive Markers [* cm]

- Cohesive markers are linking words/phrases that signal the relationship between sentences.
  - Example: using ‘all of a sudden’ when it doesn’t make sense to do so.
  - Example: <so therefore>* cm just because the bible and that might go back to separation between church and state may . . .
  - Example: the little baby mouse holds his little toy very tightly so that he doesn’t <at least>* cm lose him too
- Anaphoric References between utterances
  - Example: They were fighting. / So <he>* mr[* cm] hit <him>* mr[* cm].
- Misuse of number and gender agreement between pronouns or noun phrases across utterances
  - Example: The family didn’t care about mouse. / <It>* mr[* cm] was too busy with the picnic. ←It refers to the family, so this is a disagreement in number.

Aposiopesis [* ap]

- The leaving of a thought incomplete; a sudden breaking off in a sentence
- Aposiopesis is generally used when the participant begins a thought and then breaks off and moves to a completely different thought
  - Example: I [* ap].
  - Example: I want [* ap] [* oc] +...

Ambiguous Referent (existing words) [* mr]

- When the listener cannot tell what ‘he’/’she’/’it’ refers to
  - *note- we are not overly strict about this. If the participant uses ‘he’ without specifically telling us who ‘he’ is, we don’t code it as long as we can reasonably tell who it refers to by looking at the books pictures.
  - Do code in cases where you’re not sure who the pronoun refers to even after looking at the pictures. (Ex: He jumps on the bed and plays with the mother’s jewelry. We can’t tell who is doing this since Carl and the baby are both jumping and playing).
  - If the participant gives the character’s name but then changes the names throughout the story, this is also an ambiguous referent.
Missing Referent (omission) [* mro]

- When there is a missing referent
  - Example: *SUB: and the truck keeps going [* mro] doesn't even know that she has fallen off.

Filler Utterances [* uf]

- When a filler extends to the whole utterance. Often this will be cases of the participant giving their own commentary on the story.
  - Example: *What a beautiful day the mice are having* [* uf].
  
  *This story is really confusing* [* uf].
  
  *I don’t know* [* uf].

- Note: do not code the following as fillers:
  - Introductory statements (ex: This book is called Picnic) or closing statements (ex: The end)
  - Questions that the participant asks before beginning the story/answering the expository question

Repetitions of Utterances [* s:per]

- When an utterance is repeated
  - Example: *I ran into the tree* [* s:per]. I ran into the tree.
  - If a participant says essentially the same thing twice, you can still code it as a repetition even if the wording is not exactly the same and even if the utterances do not occur back-to-back. These do get a little tricky in terms of knowing which utterance to code (first or second). Usually for repeated utterances, we code the first utterance and keep the second. But if the utterances are separated, it is usually best to code the second utterance. For example:
    - I went there yesterday. It was nice. *I went there yesterday* [* s:per].
  - We use this code for any complete clause, even if it is subordinate and therefore not an utterance as well
Conceptually Incongruent Utterances [* exc]

- When an utterance or phrase does not make sense within the context of the story.
  - Example: <the mice abandoned the baby because they deeply hated her face.> [* exc]
  - For the expository, [* exc] codes don’t happen often but if a participant says something that is incompatible with his own argument, code it as [* exc].
    - Example- SUB: <I think healthcare is a right> [* exc]
      
      SUB: but if people can’t afford healthcare, they shouldn’t get to have it.

Par: The woman goes to <either take the book back or to buy it> [* exc].

- Sometimes a participant will say something incorrect but then go back and correct it. If this occurs in the same c-unit, code as a rephrasal. If it occurs across c units, code the incorrect parts as [* exc] and leave the correct parts alone.
  - Example- SUB: <she making the pancakes> [* exc]

  SUB: <nevermind> [* fil] Shes thinking about making the pancakes

Tangential Utterances [* tu]

- A phrase or utterance that is off-topic/doesn’t relate to the stimulus.
  - Example: The mouse went to the store. <I need bread for my dinner party on Friday> [* tu].
  - <I’m sorry> [* tu] is also a common example.

For expository, code as tangential if the participant is giving information that doesn’t answer the question (Ex: someone who tells you all about their last doctor visit without linking it to the question of whether healthcare is a right or privilege).