The Perceived Effect of Pause Length and Location on Speaker Likability and Communicative Effectiveness

Julia M. Price
Brigham Young University

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The Perceived Effect of Pause Length and Location on Speaker Likability and Communicative Effectiveness

Julia M. Price

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 Perceived Effect of Pause Length and Location on Speaker Likability and Communicative Effectiveness

Julia M. Price
Department of Communication Disorders, BYU
Master of Science

Previous studies have examined the effect of atypical speech pause on conversational fluency and how the conversational listener perceives the speaker. The present study investigated the effect of pause duration of increasing length and in differing sentential locations on listener perceptions of communicative effectiveness and speaker likability. One neurotypical male and one neurotypical female speaker recorded three sentences from the Quick Aphasia Battery, and artificial pauses of varying lengths (250 ms, 400 ms, 550 ms, 700 ms, 850 ms, and 1 sec) were inserted before the subject, verb, and object of each sentence. The six baseline (unmodified) sentences were also included among the stimuli. These samples were randomly interspersed among foil samples that consisted of 30-second recordings of six people with fluent and non-fluent aphasia of mild to moderate severity. Forty adult participants (24 females and 16 males) listened to and rated the modified and foil samples for communicative effectiveness and the perception of likability of the speaker. A review of the data revealed that pause location may negatively impact speaker likability depending on the gender of the speaker. However, due to the small sample size of speakers (one male and one female) and factors that were not controlled for in this study (e.g., speaker pitch, speech rate, resonance, articulation patterns), these results require validation through further research that utilizes a larger sample. As pause duration increased, both speaker likability and communicative effectiveness ratings decreased. These findings suggest that monitoring pause duration and location in preliminary fluency samples could be beneficial to assess fluency severity and determine appropriate treatment goals. Wordfinding treatment may want to focus on vocabulary words that serve the function of subjects and objects in sentences. Although there are limitations in the methodology and results of this preliminary study, it is hoped that this study combined with future research can help to inform assessment and treatment of people with aphasia and other neurophysiological disorders that lead to atypical pause.

Keywords: aphasia, cognitive pause, perceptual fluency, artificial pause
ACKNOWLEDGMENTS

I acknowledge with fervent gratitude the support and contributions of Drs. Nissen, Cabbage and Harmon to this thesis publication. Thank you for your help with each step of this monumental process. Your feedback and support have been invaluable. I also thank my wonderful professors who have taught me how to think critically, provide effective treatment, and seek out evidence-based research to guide my actions. Thank you to my wonderful parents who have supported and encouraged me all throughout my education. To my sweetheart, Johnny—thank you for doing more than your fair share of dishes, wiping every tear, and celebrating all the small and big successes these past two years. I could not have done this without you.
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DESCRIPTION OF THESIS STRUCTURE AND CONTENT

This thesis, *The Perceived Effect of Pause Length and Location on Speaker Likability and Communicative Effectiveness*, is part of a larger study exploring the impact of cognitive pause on speech communication in persons with aphasia. Portions of this thesis may be submitted for publication, with the thesis author being included in the list of contributing coauthors. An annotated bibliography is provided in Appendix A, the consent form used in this study is provided in Appendix B, and the verbal instructions given in the study’s training are provided in Appendix C.
Introduction

Acquired language impairment, commonly referred to as aphasia, can affect many aspects of a person’s language output and processing. The cognitive-linguistic difficulties underpinning an aphasia diagnosis (Schlenck et al., 1987) often lead to the insertion of pauses in conversation that are both more frequent and longer in duration than pauses in typical speakers. While all persons with aphasia (PWA) have word-finding difficulties to some degree, the presence of extended and frequent pause is especially prominent for patients with non-fluent types of aphasia.

Past research has suggested that pause in the speech of both typical speakers and aphasic speakers can influence the way that they are perceived by others in terms of fluency (Brennan & Williams, 1995), likability (Croteau & Le Dorze, 2001), intelligence, competence (Harmon et al., 2015), truthfulness (Kraut, 1978) and personality (Lay & Burron, 1968; Scherer et al., 1973). Speech pause has also been shown to affect the meaning of the message transmitted by the speaker (Kendrick & Torreira, 2015; Roberts & Francis, 2013), which can lead to further communication breakdowns. Reducing the frequency and duration of pauses during speech can help persons with aphasia (PWA) to increase the fluency of their speech output and avoid negative perceptions from others with whom they communicate (Roberts & Francis, 2013).

This study seeks to understand how the length of a pause within a sentence impacts the communicative effectiveness of the speaker and/or the way in which they are perceived by potential conversational partners. It further aims to determine if the syntactic location of extended pauses within a sentence (be that before the subject, verb, or object of the sentence) affects how a speaker’s communication is perceived by listeners. It is hoped that the information collected from the speech of typical speakers can establish a preliminary basis for investigating
the speech of aphasic speakers. Further understanding of typical and atypical pause length and location may help clinicians better assess the severity of an individual’s aphasia and facilitate more effective therapy.

**Patterns of Speech Pause in Typical Speakers**

Several studies have quantified the average pause length within sentences produced by typical speakers. Goldman-Eisler (1968) determined that typical speakers paused for an average of 250 milliseconds (ms), with a range from 150 to 400 ms. Pause length and frequency can vary in typical speakers due to cognitive processing time influenced by environmental factors. Pause length and frequency also varies with the function of marking of syntactic boundaries, or to denote the nature of what is being said. Pause length and the location of pause within running discourse are factors that can influence conversational fluency.

**Cognitive Processing and Environmental Factors**

There are several factors which can contribute to the frequency and length of pause in neurotypical adults. When a task requires a greater cognitive load due to complexity or environmental factors, speakers will often incorporate longer or more frequent pauses to compensate for needed cognitive processing time. Oomen and Postma (2001) looked at how multitasking affected the speech fluency of 18 native Dutch-speaking adults with no history of disfluency. The participants were asked to perform a basic picture story-telling task under two conditions: one in which they did nothing else, and one in which they simultaneously performed a “tactile-form recognition task” (feeling sandpaper figures blindly). They experienced these two conditions after an initial training with the sandpaper figures to account for the variable of task confusion. The researchers found that the participants had a greater frequency of filled pauses
and repetitions when they were in a divided attention situation. This was thought to be due to reduced ease of speech planning and increased cognitive processing needs.

**Syntactic Boundaries**

Pauses are often used to mark syntactic boundaries in running discourse. Research from Esposito (2006) and Esposito et al. (2007) investigated how empty or silent pauses (as opposed to filled pauses such as “um”) influenced discourse structure in the narratives of neurotypical Italian children. They found that shorter pauses generally indicated the retrieval of new or complex information that the children wanted to convey during conversation, and that longer pauses usually marked syntactic boundaries of terminating clauses or paragraphs. Demographically, they found that children had more frequent pauses than adults and that female children had more frequent empty pauses than male children. Yang (2004) also investigated the role of pause in marking syntactic boundaries using publicly broadcast speech samples of neurotypical speakers. The author found that factors such as speaker, gender, rate, and speech style influenced the boundary marking strength, and that longer pauses generally indicated a boundary marker, such as the end of a phrase or sentence.

**Types of Discourse**

Pauses can also be used to differentiate between different types of discourse and different types of responses, be they positive or negative. Kowal et al. (1983) examined several past studies to determine if speech types could be characterized using measures of time. They compared speech samples from storytelling to speech samples from interviews in terms of several measures of time, like phrase length, rate of speech, rate of articulation, pause duration, and the percentage of pause time/total time (p. 377). Each of the speech samples selected was rated with a minimum pause duration of 200 milliseconds (per Goldman-Eisler, 1968). When
they compared interviewing speech samples to storytelling speech samples, the researchers found that the samples had similar articulation rates but differed in use of off time (pause). They also found that the interviewing speech samples had a faster speech rate and a lower percentage of pause/total time than the storytelling speech samples. Overall, the story tellers used almost twice as much off-time as interviewees (p. 388). This study demonstrates that frequency and length of pause can give the potential listener information about the type of discourse that they are listening to. Authors in more recent years (Roberts & Francis, 2013; Kendrick & Torreira, 2015) have examined how pause length influences a conversational listener’s perception of responses to questions. They found that typical listeners in their studies associated pauses longer than 600 or 700 ms with negative responses. This study shows how pause impacts conversational discourse, the communication that occurs between two people.

**Other Factors**

Esposito et al. (2007) discussed that physical (breathing, articulation), socio-psychological (stress, anxiety), communicative (increased comprehension of listener, allowing for interruptions), linguistic (discourse segmentation), and cognitive (changing thought tracks, conceptualizing) aspects may also influence the presence of pauses in speech. These factors can lead the typical speaker to include more frequent or longer pauses in their speech. Understanding the linguistic functions and patterns of speech pause in typical communication can help clinicians identify and evaluate the impact of disordered pausing.

**Patterns of Speech Pause in Populations With Neurophysiologic Impairment**

People with neurophysiologic impairment can experience increased or disordered pausing in their speech. Hird and Kirsner (2010) cite a slightly expanded range of pause in populations with brain damage from 100 ms to 450 ms, and state that pause length varies quite a bit from
“individual to individual and context to context” (p. 527). Pistono et al. (2019) evaluated the communication of a group of adults with early Alzheimer’s disease combined with lexical-semantic decline to examine if pausing was affected by different types of discourse compared to speakers without neurophysiologic damage. After the participants produced picture-based and memory-based narratives, the researchers found that the participants with Alzheimer’s disease demonstrated increased pause lengths while producing both types of narratives and increased pause frequency during the picture-based narrative when compared to typical controls. The researchers hypothesized that increased pause frequency was correlated with semantic fluency performance and grey matter density in the anterior temporal lobe, which is thought to be a crucial center for semantic memory and speech processing. They concluded that participants’ atypical patterns of pausing during speech reflected compensation for conversational and cognitive processing deficits. Atypical pause is not uncommon in other neurologically impacted populations; Lee et al. (2019) also found that atypical pauses were common among adults with Parkinson’s disease, and were associated with the cognitive decline that can come with increased age. Older age combined with neurological disease or damage can lead to longer and more frequent pauses in patients.

Persons with aphasia demonstrate distinct placement and length of pauses when compared to typical speakers. In aphasic speakers, particularly those with good comprehension, poor production, or a mixture of both, it is more common to make “prepairs” (searching, pausing) during speech than repairs (correcting what was previously spoken; Schlenck et al., 1987). Oomen, Postma, and Kolk (2001) expanded on this research and looked at the ratio of covert repairs (“prepairs”) to overt repairs (“repairs”) in patients with Broca’s aphasia and in typical controls. For this study, the researchers defined overt repairs as making corrections to
semantic and phonological errors after they happened. They defined covert repairs as syllable, word, multiple word and phrase repetitions/restarts. They found that the patients with aphasia demonstrated higher proportions of covert repairs than typical controls. The researchers thought that this was due to patients with aphasia having a higher reliance on pre-articulatory monitoring (detecting and repairing errors before speech output). Reasons for this reliance were hypothesized to be reliance on production-based monitoring secondary to brain injury or a desire to “[optimize] speech output before articulation” (p. 639). This study confirmed Schlenck’s suggestion that people with Broca’s aphasia tend to make more “prepairs,” or covert repairs in their speech.

The Effect of Environmental Factors on Atypical Speech Pause

Harmon, Jacks, and Haley (2019) and Harmon, Jacks, Haley, and Bailliard (2019) both discuss the effect of divided attention tasks on pausing rate and duration in PWA. The first study compared speakers with aphasia who also have apraxia of speech (AOS) versus speakers with aphasia alone to examine if the participants’ cognitive-linguistic processing and motor processing were different. The study also sought to better understand how cognitive load affected speech fluency by having participants retell short stories while distinguishing between a high and low tone simultaneously and without other interfering cognitive tasks. The researchers found that both groups of speakers with aphasia differed from a group of typical speakers in terms of pause rate and duration. However, the two groups of PWA did not differ from each other, apart from more repetitions and longer samples from those with AOS during the narrative retell. All speakers with aphasia experienced less fluent speech output when they had to engage in simultaneous tasks and incorporated longer pauses as compared to participants without neurophysiologic impairment.
The second study by Harmon, Jacks, Haley, and Bailliard (2019) examined participants with mild and moderate aphasia compared to neurotypical individuals. The participants retold short stories in isolation and while performing a concurrent task. Their responses were analyzed for speed (speech rate, pauses, repetitions), story retell accuracy, and perceived effort. The participants with aphasia were affected more in their spoken language and emotional/behavioral reactions by the dual task than the participant controls. The different severity groups of aphasia demonstrated differing compensatory strategies—the participants with moderate aphasia kept up the same speed while speaking without significant increases in their pauses but declined in accuracy (defined by the researchers in terms of “correct information units”) compared to participants with mild aphasia. Both groups of participants experienced negative reactions while faced with the dual task, such as feelings of frustration, stress, irritation, lost concentration, and decreased performance. However, the group with mild aphasia was better able to implement strategies such as deemphasizing errors and pausing more frequently in order to maintain accuracy, despite the increased cognitive load. This study demonstrated that because dual tasks increase cognitive load, they are especially challenging for PWA and lead to longer and more frequent silent pauses. Since PWA tend to use longer pauses than typical speakers during lexical retrieval, it is possible that those pauses could be mistaken for performing the function of marking syntactic boundaries in speech.

The Impact of Atypical Pause on Listener Perceptions

Perception of Message Transmission

Atypical pause plays an important role in how the speaker’s message is transmitted to the conversational listener. If a speaker has extended or more frequent pauses in their speech, this may unintentionally send a different message than they intended. In their 2015 study, Kendrick
and Torreira looked at telephone conversations where one speaker proposed a course of action and the other speaker paused for different amounts of time before responding. The researchers found that regardless of the positive or negative nature of the response, if the pause length was 700 ms or more, the response was perceived as negative in a nonpreferred “turn format.” Roberts and Francis (2013) similarly found that after a pause time of 600 ms or more following a proposition, raters tended to think that the response was negative. Because cognitive pause leads to prolonged pauses between responses, persons with cognitive processing deficits may be perceived as transmitting nonpreferred or negative messages. This impacts how effectively they transmit their intended message to others.

The presence of extended pause during speech can also affect how the overall fluency of the speaker is perceived. Bosker et al. (2012) examined the perceived fluency of L2 Dutch speakers in terms of pause, speed, and repair. They found that pause and speed of speech are the most influential measures in regard to perceived fluency, whereas repair does not elicit significant perceptual changes.

Extended or frequent pauses can also affect the flow and fluency of conversation. When comparing speech samples of adults with chronic aphasia to typical adults of a similar demographic, Angelopoulou et al. (2018) found that the presence of aphasia can lead to pauses that last longer and occur more frequently in conversational speech. Extended pause is indicative of affected sentence planning abilities resulting from damage to the brain’s left hemisphere. These longer and more frequent pauses can affect a person’s quantity of speech. Deloche et al. (1979) similarly analyzed speech samples from patients with aphasia and found that the most pertinent variable in explaining how the speech of speakers with aphasia differed from typical controls was mean pause length.
Dede and Salis (2020) compared spoken narratives of adults with aphasia and adults with typical speech, with an emphasis on the differences between controls and participants with latent aphasia. They found that the two control groups were similar to the latent aphasia group in terms of articulation rate, pure word rate, and episodic organization of narratives, but different in terms of number of words produced, silent pause duration, and speech rate. Those with aphasia produced about half the number of words as the neurotypical group, had longer pause durations, and had a slower speech rate. These differences were thought to be due to a processing speed deficit (slowness in performing cognitive tasks) that makes it more difficult to take in information from many sources at the same time. Harmon, Jacks, and Haley (2019) also looked at narrative production in speakers with aphasia and found that their speech fluency was reduced and pause length increased when compared to typical speakers, and that these effects worsened when they were required to participate in divided-attention tasks.

**Perception of Speaker Personality and Psychological Attributes**

Pauses within discourse have been shown to influence the way that conversational partners view the speaker, whether that be in terms of confidence, willingness to help, or overall competence (Brennan & Williams, 1995; Croteau & Le Dorze, 2001; Harmon et al., 2015; Kendrick & Torreira, 2015; Kraut, 1978; Lay & Burron, 1968; Roberts & Francis, 2013; Scherer et al., 1973). Many of the studies conducted on this topic were conducted with typical speakers, whose speech was modified by the speaker themselves or through technology. A few studies have also been conducted using speech samples from speakers with aphasia.

**Speaker Confidence.** Extended and frequent pauses can affect the listener’s perception of a speaker’s confidence. Several studies have approached this subject using typical speakers, with varied foci in their perceptual ratings. Scherer et al. (1973) had actors record “linguistically
confident" and “linguistically doubtful” versions of a legal defense, with the linguistically confident voice using fewer and shorter pauses than the doubtful voice. Their data indicated that the recorded speech with more frequent and longer pauses was perceived as having negative attributes when compared to the “confident” speaker. Lay and Burron (1968) used recordings of “hesitant speech,” which had a high rate of pauses, and “non-hesitant speech,” which shortened the pauses artificially. In this study, the “hesitant” speaker was rated as less fluent and was not assigned as many desirable and positive adjectives as the “non-hesitant” speaker. Pauses in speakers with aphasia are also found to differ perceptually from pauses in typical speakers in terms of liveliness and comprehensibility (Groenewold et al., 2014). Groenewold et al. (2014) specifically noted that typical speakers were rated higher in liveliness and comprehensibility overall, and that aphasic speakers were rated higher in liveliness when they used direct speech (direct quotations) and lower in liveliness when telling a narrative.

Speaker Willingness to Help. When longer pauses occur in response to a question or proposition, the speaker may be perceived as unwilling to help or proffering a nonpreferred response. Roberts and Francis (2013) and Kendrick and Torreira (2015) both examined this aspect of extended pause using simulated telephone conversations. Roberts and Francis (2013) found that listeners associated a negative response after a lag time of 600 ms, with statistically significant differences in negativity ratings when comparing pause times of 700 to 800 ms. Kendrick and Torreira (2015) similarly found that participants nonpreferred responses with turn transitions of 700 ms or more. They also found that preferred responses “come quickly and take simple forms,” while less preferred responses are often delayed and are more complex (p. 256). In this study, regardless of the positive or negative nature of the response, it was the pause length that determined whether the response was perceived as a preferred form of conversational turn-
taking. PWA that exhibit extended pausing in their speech may experience negative misperceptions from listeners regarding their intended message.

**Speaker Competence and Likability.** Brennan and Williams (1995) found that long pauses while answering a question can influence a listener’s perception of whether that person does or does not know the answer to a question. Harmon et al. (2015) conducted a study wherein typical speakers rated unaltered aphasic speech, simulated fluent speech, and neurotypical speech on how they perceived the speech, the speaker’s attributes, and their feelings about the audio samples. The researchers found that the samples of neurotypical speech were rated more favorably than the samples of aphasic speech, and the modified samples of aphasic speech were rated more favorably than the non-modified samples. Ratings for speech intelligibility, ease of storytelling, intelligence, confidence, competence, and friendliness were negatively impacted for people with aphasia in comparison to neurotypical speakers. Listeners also reported feeling less patient, comfortable, and at ease when listening to people with aphasia.

**Purpose of This Study**

Previous studies have examined the effect of atypical speech pause on conversational fluency and how the conversational listener perceives the speaker. However, there is a need for research that quantifies how the specific duration of pause within a sentence affects a speaker’s ability to communicate effectively and how they are perceived by a conversational listener. Thus, the research aims of this study are the following:

1. How do within-sentence pauses of increasing length affect how the speaker is perceived in terms of likability and communicative effectiveness?
2. Does speaker gender influence listener perceptions of within-sentence pausing?
3. Does the syntactic placement of extended cognitive pause within a sentence (be that before the subject, verb, or object of a sentence) influence the communicative effectiveness and likability of the speaker?

Methods

Participants

Forty adult participants were recruited from the local university and community via word of mouth for the study (24 females and 16 males) who had typical hearing and were native English speakers. No participants reported a history of speech or language disorders. While specific demographics for participants were not recorded, a preliminary survey of participants indicates the participants were adults above 18 years of age. Many were of college age (generally 18-26), and the remaining participants were older adults. Some of the participants were enrolled in an undergraduate class in a communication disorders program, and had been introduced to the concept of aphasia, while the majority of listeners did not have a background in communication disorders. A preliminary hearing screening of pure tone testing was performed at octaves starting at 1000, 2000, 4000 Hz at 25 dbHL thresholds to determine if the participants met the criteria for hearing ability. Procedures of sanitization of participant’s hands and equipment was implemented, as well as social distancing to promote participant and researcher safety. Listeners were given monetary compensation for their participation in the study.

Stimuli

For this study, discourse samples were created using a 29-year-old neurotypical male speaker and a 25-year-old neurotypical female speaker. These samples consisted of three sentences that were taken from the Quick Aphasia Battery (QAB; Wilson et al., 2018). The sentences used were “the girl is chasing the boy,” “the sun sets in the West,” and “the dog sleeps
on the floor.” The speakers sat in a sound attenuating booth and recorded the sentences on a YETI USB microphone. After the files were saved as .wav files through a PC computer, Adobe Audition editing software was used to analyze the natural acoustic features of the sentences and to artificially insert pauses of varying lengths (250 ms, 400 ms, 550 ms, 700 ms, 850 ms, and 1 sec) before the subject, verb, and object of each sentence. The pause lengths began at 250 ms because this is the pause length that has been established in past literature as “average” for a typical speaker (Goldman-Eisler, 1968). A baseline sentence with no modifications was also included among the stimuli. The speech samples were normalized for intensity level. The test stimuli were randomly presented to listeners interspersed by foil stimuli. The foil stimuli consisted of approximately 30-second speech recordings produced by six speakers with fluent and non-fluent types of aphasia of mild and moderate severity.

**Procedures**

Prior to initiation of the study, the study protocol was approved by the Brigham Young University Institutional Review Board (BYU IRB). Each listening session was structured to take approximately 60 minutes. The participants read and signed an informed consent form approved by the BYU IRB. They then participated in a hearing screening in a separate area. Following the hearing screening participants entered a sound attenuating booth, received verbal instructions and performed a short training with five control sentences. Participants then listened to two 20-minute blocks of mixed stimuli. The stimuli included the targeted stimulus set with pauses of different lengths placed before the subject, verb, and object in a sentence as well as a set of foil speech sample from aphasic speakers that were 30 seconds in length. The stimulus items were presented in randomized order to listeners while seated in a sound-attenuating booth. Listeners used a visual analog scale to rate the communicative effectiveness of the expressed message and
likability of the speaker for each sample. As seen in Figure 1, the visual analog scale provided options to rate the factors on a sliding scale with markers at “very poor,” “poor,” “average,” “good,” and “very good.” The results of the Visual Analog Scale rating values were converted to values from 0-100 and automatically exported into a spreadsheet by a custom-written software program.

Figure 1

Visual Analog Scale Used to Rate Communicative Effectiveness and Likability of Speakers

Statistics

A mixed-model repeated measures analysis of variance (ANOVA) was performed to analyze these data with within-subject factors of speaker gender, pause position, and pause duration. The dependent variables were listener ratings of communicative effectiveness and likability.

Results

The effects of speaker gender, pause position, and pause duration on communicative effectiveness and speaker likability were determined by the evaluations of listener rating
comparisons. A detailed listing of the mean listener ratings and standard deviations across
speaker gender, pause position, and pause duration for the male and female speakers are listed in
Tables 1 and 2, respectively.

**Speaker Gender**

*Communicative Effectiveness*

The ANOVA indicated a significant main effect of speaker gender for the measure of
communicative effectiveness, $F(1, 38) = 29.72, p < .0001$, partial $\eta^2 = .44$. Listeners rated the
stimuli produced by the female speaker as less effective ($M = 61.8$) than the male speaker ($M =
65.6$). An interaction between speaker gender and pause duration was also found, $F(6, 228) =
16.38, p < .0001$, partial $\eta^2 = .30$. As shown in Figure 2, as the pause duration increased the
difference between the female and male speaker also decreased. No other interactions were noted
for speaker gender.

*Likability*

The ANOVA indicated a significant main effect of speaker gender for the measure of
likability, $F(1, 38) = 9.61, p < .005$, partial $\eta^2 = .20$. Listeners rated the stimuli produced by a
female speaker as less likable ($M = 53.9$) than the male speaker ($M = 57.3$). An interaction
between speaker gender and pause position was found, $F(2, 76) = 5.30, p < .01$, partial $\eta^2 = .12$.
As shown in Figure 3, speaker likability was rated the highest for both male and female speakers
when the pause was located before the verb of the sentence, as opposed to the subject or object
of the sentence. An interaction was also found between speaker gender and pause duration, $F(6,
228) = 15.29, p < .0001$, partial $\eta^2 = .29$. As shown in Figure 4, as pause duration increased,
likability ratings decreased (most notably with the male speaker). The difference between the
likability of the male and female speaker decreased as pause duration increased. No other interactions were noted for speaker gender.

Table 1

*Ratings of Communicative Effectiveness and Likability Across Utterance Position and Pause Duration for Female Speaker*

<table>
<thead>
<tr>
<th>Utterance Position</th>
<th>Pause Duration&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Communicative Effectiveness&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Likability&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Subject Baseline</td>
<td>66.39 16.05</td>
<td>57.94</td>
<td>13.83</td>
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<td>250</td>
<td>63.23 16.71</td>
<td>55.23</td>
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<tr>
<td>400</td>
<td>59.98 16.28</td>
<td>52.52</td>
<td>12.92</td>
</tr>
<tr>
<td>550</td>
<td>61.06 18.11</td>
<td>52.44</td>
<td>14.58</td>
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*Note.* <sup>a</sup> Calculated in milliseconds; <sup>b</sup> calculated on a 0 – 100 scale
Table 2

*Ratings of Communicative Effectiveness and Likability Across Utterance Position and Pause*  
*Duration for Male Speaker*

<table>
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<tr>
<th>Utterance Position</th>
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<th>Communicative Effectiveness(^b)</th>
<th>Likability(^b)</th>
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</table>

*Note.* \(^a\)Calculated in milliseconds; \(^b\) calculated on a 0 – 100 scale
Figure 2

*Listener Ratings of Communicative Effectiveness Across Speaker Gender and Pause Duration*

[Graph showing communicative effectiveness across different pause durations for female and male speakers.]

Figure 3

*Listener Ratings of Likability Across Speaker Gender and Utterance Position*

[Graph showing likability across different utterance positions for female and male speakers.]
Pause Position

Communicative Effectiveness

The ANOVA indicated no statistically significant differences or interactions for communicative effectiveness as a function of pause position within the sentence.

Likability

The ANOVA indicated a significant main effect of pause position for the measure of likability, $F(2, 76) = 4.05, p < .05$, partial $\eta^2 = .10$. Listeners rated the pauses located in the position before the verb as more likable ($M = 56.4$) than in the position before the subject ($M = 55.5$) and the object ($M = 54.9$). No other interactions were noted for pause position.
**Pause Duration**

**Communicative Effectiveness**

The ANOVA indicated a significant main effect of pause duration for the measure of communicative effectiveness, $F(6, 228) = 37.48, p < .0001$, partial $\eta^2 = .50$. As shown in Figure 5, as pause duration increased, communicative effectiveness decreased overall. No other interactions were noted for pause duration.

**Likability**

The ANOVA indicated a significant main effect of pause duration for the measure of likability, $F(6, 228) = 31.48, p < .0001$, partial $\eta^2 = .45$. As shown in Figure 5, as pause duration increased, likability ratings decreased overall. No other interactions were noted for pause duration.

**Figure 5**

*Listener Ratings of Communicative Effectiveness and Likability Across Pause Duration*
Discussion

This study was initiated to determine the impact of pause duration and syntactic location on the perceived communicative effectiveness and likability of the speaker. In order to understand the impact of these variables, the findings will be reported according to each of the research questions outlined previously.

The Influence of Within-Sentence Pauses of Increasing Length on Listener Perceptions

Prior to the initiation of this study, it was anticipated that increased pause duration would correlate with decreased communicative effectiveness. A review of the data showed that this initial hypothesis was correct. As shown in Figure 4, as pause duration increased, communicative effectiveness decreased. These findings are similar to those of Angelopoulou et al. (2018) and Bosker et al. (2012), who found that increased pause duration was correlated with decreased perceived fluency and decreased communicative effectiveness overall.

It was also anticipated that increased pause duration would correlate with decreased perceived likability of the speaker. The findings of the study corroborated this hypothesis, as can also be observed in Figure 4. These findings are supported by past research from Harmon et al. (2015), who found that samples with shorter/more typical pause duration were correlated with more favorable ratings for intelligence, confidence, competence, and friendliness. Listeners also reported decreased patience, comfort, and ease when listening to aphasic speakers with increased pause duration.

With both communicative effectiveness and speaker likability, it was hypothesized that the factors would remain stable until a certain point, and then begin to decrease at a cutoff duration (e.g., ratings would remain stable for speaker likability until 600 ms, and then begin to decrease). Kendrick and Torreira (2015) and Roberts and Francis (2013) both found that
messages were perceived as negative and/or nonpreferred when pause following a request was more than 700 ms. Their findings lend credibility to this alternate hypothesis; however, the findings demonstrated a relationship that was somewhat linear rather than an abrupt change in listener ratings at 700 ms. There was a more distinctive drop in ratings between the baseline sentences and the sentences with a 250 ms pause—it is possible that the baseline speech rate of the speakers could have affected the listener’s reception of this change. Since the baseline speech rate was normal and fluent, any change caused the listener to notice. Perhaps if the speaker had aphasia and had a slower baseline speech rate, the listener would be more inclined to expect longer pauses and the drop in perceptual ratings would not have occurred between baseline and the first set of modified sentences.

The Impact of Speaker Gender on Listener Perceptions of Within-Sentence Pausing

Initial research into the effects of pause duration did not delineate any effect of speaker gender, so it was unclear if speaker gender would have any effect on the data. The data collected indicated multiple significant effects for speaker gender, which are reflected in Figures 2 and 4. Overall the female speaker was rated to have decreased communicative effectiveness and to be less likable than the male speaker across all pause durations. However, the difference between the likability and communicative effectiveness of the male and female speaker decreased as pause duration increased. Notably, there were clear decreases in likability and communicative effectiveness as pause duration increased with the male speaker that were not as pronounced in the female speaker.

Although the difference between gender was found to be statistically significant, the real-world difference between the mean ratings may be minimal. This is implicated by multiple factors. For example, in this study only two speakers were used, one male and one female
speaker. Considering that the sample of speakers was so limited, it is highly probable that any differences are attributable to individual speaker differences rather than due to any generalized gender differences. Additionally, there were several factors that were not controlled for such as pitch, articulation patterns, resonance, and speech rate. As such, any one of these factors may have contributed to the reaction of the listeners to the different speakers’ voices.

The Impact of Syntactic Placement of Pause Within a Sentence on Listener Perceptions

It was unclear in the initial stages of research how pause location would impact communicative effectiveness and speaker likability; for this reason, this variable was under investigation in the research study. Research from Esposito (2006), Esposito et al. (2007) and Yang (2004) has shown that pauses can mark syntactic boundaries in typical speech. With this information, it was hypothesized that longer pauses could indicate the completion of a thought and that this could interact with pause location in an interesting way. Perhaps if the pause were located near a less common part of the sentence, like in front of the object, this could impact the delivery of the sentence and reduce communicative effectiveness overall.

The results of the study indicated that speaker likability was rated the lowest for the male speaker when the pause was located before the object of the sentence and was rated the lowest for the female speaker when the pause was located before the subject of the sentence. When pauses were in front of the verb of the sentence, both speakers received higher ratings for speaker likability. These results help us to understand that a speaker may be perceived as more likable if they avoid prolonged pause before the subject or object of the sentence. Communicative effectiveness, on the other hand, showed no significant difference between pauses in different locations of the sentence. Since there is no significant correlation, the
interaction of pause location and communicative effectiveness may not be as pressing to consider when evaluating atypical pause.

**Limitations**

Several limitations should be noted for this study. First, many participants in this study were of college age, so the listener population was not evenly representative of all ages. The participant sample consisted of 40 listeners; while this is a respectable size, the validity of the results could have been strengthened by a larger sample of listeners. Although the researchers attempted to provide clear instructions for the rating of stimuli, it is possible that some of the participants may have had a positive bias, where they may have been hesitant to rate the target speakers as unlikable.

There were also limitations in the stimuli used. Only three sentences were represented in the assessed stimuli; it would be useful to assess listener ratings across a larger set of stimuli, or one with more syntactical diversity. It may have been more effective to have the listeners listen to the stimuli in paired comparisons, rather than having all the stimuli and durations randomized into one block.

While the pauses that were used represented a range of typical to atypical pause lengths, it might have been beneficial to include longer pauses (1.5 seconds, 2 seconds, or 3 seconds). These longer durations could potentially have better represented the real-world patterns of people with aphasia or other neurological conditions. The pauses that were inserted into the stimuli were artificially created; while this allows for more exact measurement of data, it does not simulate authentic pauses like those by speakers with aphasia or neurophysiological impairments. The present study focused more on unfilled pauses (silent); in speakers with aphasia, it is more likely that they will produce both unfilled and filled pauses in their speech (interjections like “um” and
“uh”). Along that same line of thought, the speakers used were typical speakers which were more readily available. Had the samples been from speakers with aphasia, the results may have been more representative of the populations that were in mind with this line of research.

The way in which the stimuli ratings were organized also could have been different. It is possible that it would have been beneficial to use a five or seven point Likert scale with individual buttons rather than having the participants drag a slider to the left or right. With individual radial buttons, it could have made the listener’s impressions of the speakers more clear-cut. It also may have been beneficial to test only one of the listener perceptions at a time (either communicative effectiveness or likability). It is possible that the results may have been influenced by both factors being rated at the same time, with likability always rated last. Another way to address this issue could have been to randomize the order in which the factors were rated.

Finally, since significant effects were found for speaker gender in the data, it would be beneficial to do a future study that includes multiple speakers from each gender to confirm these significant effects. The present study only used two speakers, and so does not represent a wide variety of speakers.

**Impact of Findings on Clinical Practice**

Although typical speakers were used in this study, it is hoped that the data collected from this research will benefit speech-language pathologists who work with populations who experience increased or disordered pausing as a result of cognitive factors, such as people with aphasia and people with neurophysiological impairment (Hird & Kirsner, 2010; Lee et al., 2019).

A spoken sample is often collected as part of aphasia assessment and analyzed for deviant speech and language characteristics. Fluency is also analyzed to determine the possible type or category of aphasia. Research shows that increased duration and frequency of pausing can have a
negative impact on speech fluency (Bosker et al., 2012; Brennan & Williams, 1995). The results from this study indicate that increased pause duration is correlated with decreased speaker likability and communicative effectiveness. They also show that speakers who experience extended pause before the subject or object of the sentence may be perceived as less likable. With this information, when assessing the fluency of speakers, clinicians can record pause length and placement and use that information to inform treatment targets.

Clinicians who are targeting wordfinding may wish to focus on more specific lexical categories, such as words that commonly serve as the subject or object of a sentence. Focusing on these categories may improve speaker likability overall. Since the results demonstrated that pause duration has a significant effect on both speaker likability and communicative effectiveness, reducing pause length may serve as a higher priority. Particularly, clinicians may wish to provide their patients with strategies to reduce cognitive pause so that it is closer to 250 milliseconds. Aside from the baseline sentences, pauses that were 250 milliseconds in duration yielded the most positive ratings for speaker likability and communicative effectiveness. Overall, further understanding of typical and atypical pause length and location may help clinicians better assess the severity of an individual’s aphasia and facilitate more effective therapy. The ultimate goal of speech therapy is to facilitate effective communication across multiple settings. Assisting patients in reducing the frequency and duration of pause serves that higher purpose.

Conclusions

Despite the limitations described above, it is hoped that the findings of this study will inform assessment of speech fluency and naturalness for speakers with aphasia or other neurophysiological impairments. The data collected from this study help us to understand that increased pause duration negatively impacts the listener’s perception of communicative
effectiveness and speaker likability. The data also shows that pauses placed before the verb of the sentence are perceived more positively than pauses in other syntactic locations. With this knowledge, clinicians can provide patients with strategies to decrease pause duration, increase word-finding ability, and improve communicative effectiveness. The hope is that as these factors improve, quality of life for patients with aphasia and other neurophysiological conditions will also improve.
References


https://doi.org/10.1016/j.neuropsychologia.2018.12.018

http://doi.org/10.1121/1.4802900

https://doi.org/10.1016/0092-6566(73)90030-5

https://doi.org/10.1016/0093-934X(87)90100-3


http://www.isca-speech.org/archive/sp2004
APPENDIX A

Annotated Bibliography


**Objective:** To look at the distribution and linguistic effect of pause in patients with aphasia and better understand the implications that pause generates concerning cognitive status. **Method:** The researchers selected 18 patients with chronic aphasia following a left hemisphere stroke to compare to a control group of 19 healthy adults. The two groups were of a similar demographic background. Both groups produced speech samples during the administration of the *Boston Diagnostic Aphasia Examination-Short Form* assessment which were transcribed and annotated for silent pauses using ELAN. The pauses were analyzed for differences between and within groups. **Conclusions:** Pauses of varying lengths can be found among people with and without aphasia, but the presence of aphasia can lead to pauses that last longer and occur more frequently in conversational speech. These longer and more frequent pauses can affect the quantity of speech and are indicative of affected sentence planning abilities due to aphasia. Clinicians can use pause as a marker of cognitive change in their clinical language assessment of patients with aphasia. **Relevance to current study:** This study is important because it demonstrates the effect that aphasia has on conversational fluency. This study demonstrates the quantitative effect of pause, and the current study will demonstrate the qualitative effect of pause.

**Objective:** To determine the impact of speed, repairs, and pauses in how listeners perceive verbal fluency. **Method:** Four experiments were conducted to measure the previously mentioned aspects of fluency through the ratings of untrained perceptual listeners. All four studies rated speech materials from L2 Dutch speakers, but each experiment rated the materials in distinct ways. In the first experiment untrained listeners rated the perceived fluency with modified pause, speed, and repair. The second, third, and fourth experiments looked at the perceptual sensitivity of untrained listeners regarding these three elements, with each experiment focusing on one element of the three.

**Conclusions:** Pause and speed of speech are the most influential measures in perceived fluency, while repair does not elicit significant perceptual changes. Listeners will base their judgement of overall fluency on the factors that are most important to them rather than on their sensitivity to these factors. **Relevance to current study:** Like this study, the proposed study will examine the perceptual fluency of speakers based on pauses in speech. The current study will focus on this one element rather than including speed and repair.


**Objective:** To determine whether listeners are sensitive to the metacognitive states of others based on their pauses and prosody. **Method:** The researchers replicated a past study
conducted by Smith and Clark in which the 14 participants were recorded while being
tested on 20 general knowledge questions of varied difficulty, surveyed about their
feeling-of-knowing (FOK) for these questions and tested for recognition of answers.
Feeling-of-knowing is a person’s ability to assess and monitor their own knowing; it has
to do with length of time it takes to retrieve something from the mind in response to a
question. For example, a person with a high FOK will retrieve answers faster from their
memory but search longer for elusive answers before giving up because they feel that
they know the answer. A person with low FOK will take longer to retrieve answers but
may not spend as much time searching for the answer. The researchers then conducted a
second experiment in which 48 new listeners were asked to listen to the spontaneous
verbal responses proffered in the first experiment and were tested on their feeling-of-
another’s-knowing. The objective was to see if they could perceive things about the
speaker’s metacognition based solely on the way that the speaker responded. The
responses in the first study were analyzed and edited down to 60 responses based on
several qualifying factors in preparation for the study. The researchers’ final experiment
focused on filled pauses (e.g., um, err) vs. unfilled pauses and how that affects FOK
judgements in a group of 72 listeners. **Conclusions:** In the first study, the researchers
found that higher FOK led to producing answers more quickly (both correct and
incorrect), and that participants used rising intonation more often for incorrect answers
compared to correct answers. They noted that people often display metacognitive
information about their knowledge of the answer as demonstrated by pause before
answering and intonation. In the second study, the researchers found that longer pauses in
answers led to lower FOK ratings and longer pauses in non-answers led to higher FOK
ratings. Overall, listeners were able to determine the metacognitive information about the state of knowledge in speakers while answering questions. Listeners would often use their own FOK as a reference to predict whether the speaker knew the answer. In the third study, they found that 76.3% of the subjects used hesitations or pauses to determine whether the speaker knew the answer or not. The length of filled pauses was more important than the filler used. If a speaker used an unfilled pause before answering, speakers were more likely to think that they knew the answer, but if they used an unfilled pause before saying something like “I don’t know,” the speakers were more likely to think that they did not know the answer (and vice versa for filled pauses). *Relevance to current study:* In this study, “long pauses led to lower FOK ratings of answers and higher FOK ratings of non-answers than did short pauses...that is, in question-answering, both FOK and FOK are negatively correlated with latency to answers and positively correlated with latency to non-answers” (p. 390). In other words, long pauses while answering a question can influence a listener’s perception of whether that person does or does not know the answer to a question. This is another aspect of perception of pauses that the current study could explore.


*Objective:* To investigate whether persons with aphasia are perceived differently by their spouses as compared to how typical speakers are perceived by their spouses. *Method:* The researchers first examined the functional abilities of 21 people with varied types of aphasia using the *Functional Status Index*. They then gave the *Adjective Check List* to the spouses of those PWS and to 25 spouses of control (typical) speakers that were matched
for age, level of education, work, language spoken, and years of marriage. This checklist consists of several scales that rate aspects of personality. Five of those scales were found to have statistically significant differences between and within groups: likability, achievement, endurance, order, and succorance (dependence on others). A likability index was calculated from the results using the formula of \[\text{likability} = \frac{\text{number of favorable items checked}}{\text{number of favorable items checked} + \text{number of unfavorable items checked}}\].

**Conclusions:** The researchers did not find a correlation between functional status and the scores received on the ACL. Multiple ANOVAs performed on the results of the ACL found that spouses of PWA tended to use more unfavorable adjectives to describe their partner, saw their partner as putting less emphasis on neatness, organization, and planning, and saw them as soliciting more sympathy and support from others compared to typical controls. The researchers also found that wives of men with aphasia perceived them as “striving less to be outstanding in pursuits of socially recognized significance” (p. 816) and less persistent. Traditional gender and generational views played a role in the results, and type 1 error was not controlled for in this preliminary study. More research that investigates pre-aphasia factors, time post onset, perceptual change, and researcher influence would be beneficial.

**Relevance to current study:** This study demonstrates that PWA are perceived differently by their spouses than are typical speakers. Although pause/communication was not singled out as a contributing factor to these results, many of the scales that were found to be significantly different (likability, achievement, etc.) are affected by communication difficulties. The present study explores that aspect in relation to how PWA are perceived by others.

*Objective:* To look at the temporal/episodic elements of the discourse of people with aphasia to better understand their language characteristics and see whether the researcher’s measures were able to differentiate between people with no, subtle, and severe language difficulties. It was especially important to the researchers to distinguish between latent/mild aphasia and neurotypical speakers since past studies and past assessments have been inconsistent in doing so. *Method:* The researchers recruited 30 participants from Aphasia Bank, 10 of whom had latent/mild aphasia, 10 of whom had anomic aphasia, and 10 of whom were neurotypical controls. The participants produced narratives of the story of Cinderella, which were analyzed using Praat software for the duration of speech, disfluencies of silent ($\geq 200$ ms) and filled pauses, and discourse structure. *Conclusions:* The two control groups were similar to the latent aphasia group in terms of articulation rate, pure word rate, and episodic organization of narratives, but different in terms of number of words produced (those with latent aphasia produced about half the number of words as the neurotypical group), silent pause duration (those with latent and anomic aphasia had longer pause durations than the neurotypical group), and speech rate (those with latent/mild aphasia had a slower speech rate than the two controls). The differences that are seen between the latent aphasia and control groups are mainly due to a processing speed deficit (slowness in performing cognitive tasks) that makes it more difficult to take in information from many sources at the same time. *Relevance to current study:* This study better informs understanding about the pause
duration and speech patterns of people with latent aphasia and anomic aphasia and neurotypical controls. It also provides information as to what could cause silent pauses in people with aphasia and shows that silent pauses are often present with even the mildest aphasia cases (thought to be due to deficits in processing speed) and make their speech different from neurotypical controls.


**Objective:** To determine the contribution of phonation rate and frequency/duration of pauses to overall verbal rate in patients with aphasia and better understand how they relate to encoding impairments. **Method:** The researchers collected spontaneous speech samples from five male aphasic patients during an unstructured interview and during the description of a picture to observe the effect of constraint on observed behavior. Those samples were then analyzed for phonation rate, number of silent pauses, and the mean duration of those silent pauses. The samples were analyzed in comparison to typical speaker variables. **Conclusions:** As compared to typical speaker variables (who demonstrated increased pausing time and duration and a reduction in verbal rate while describing a scene), the speakers with aphasia had an increased verbal and phonatory rate and shortened pause duration while describing a scene. Speakers with aphasia (especially Broca’s aphasia) tended to demonstrate slower verbal rate and longer mean pause time during the interview situation in contrast to typical speakers. The data from both situations demonstrated that mean pause length was the most pertinent variable in explaining how the speech of speakers with aphasia differed from typical controls,
followed by modified phonation rate. **Relevance to current study:** This study demonstrates that persons with aphasia tend to have a greater mean pause length on average than typical speakers. The current study will further analyze temporal variables to quantify the length of pause that leads to negative perceptions from outside listeners.


**Objective:** To look at the impact that pausing strategies have on discourse structure and investigate how pauses are correlated with additional information conveyed. **Method:** Spontaneous narratives from male and female Italian children (all approximately nine years old) were recorded through audio and video and were analyzed for empty speech pauses. Those pauses were categorized according to duration. This study was preliminary to the study discussed below from Esposito et al. (2007). **Conclusions:** Their pauses were generally found to play a role of recovering added information that they wanted to convey during conversation. Longer pauses had a lower probability of conveying added information and a higher probability of marking discourse boundaries. **Relevance to current study:** Former research has shown that PWA tend to take longer to retrieve information and have longer than typical pauses in their speech. Because of these long pauses, it is possible that others could see them as marking boundaries in their discourse and being finished with a thought when in fact they are not, which could lead to interruptions or awkward silences in conversation.

**Objective:** To investigate how empty speech pauses are used in the speech of typical speakers to develop better interactive AI systems. **Method:** The researchers collected spontaneous narratives from male and female children (four males and four females) and adults (two males and two females) and analyzed their narratives for empty speech pauses. The narratives were based on a 7-minute cartoon which the participants watched. The participants were prepared so that they were used to/comfortable with the recording equipment and in a friendly, natural environment (to eliminate socio-psychological pauses). **Conclusions:** Most empty speech pauses indicated that the speaker was conveying additional/complex information or marked a clause or paragraph boundary. Instinctual timing barriers of discourse were consistently present among subjects. The writers identified physical, socio-psychological, communicative, linguistic, and cognitive types of pauses. Children tended to pause more than adults and female children had more empty pauses than male children. Many pauses were included in order for the speaker to retrieve information from memory that they were seeking to convey. **Relevance to current study:** To understand what an atypical pause sounds and looks like, it is important to understand what a typical pause sounds and looks like. It is also important to understand the function of typical pause as compared to atypical pause. As the current study will look at outside perceptions of typical and atypical pause lengths, this information will be helpful to understand.
Objective: To determine the effects of speech on how people with aphasia are perceived in terms of liveliness and speech comprehensibility. Method: The researchers recruited 37 undergraduates who were enrolled in a clinical language course and had normal hearing. Speech samples from interviews with 10 aphasic speakers (Broca’s/Anomic) and 10 age and gender matched speakers were rated for liveliness and comprehensibility. The samples consisted of narratives with some direct speech constructions (quotations of words). Conclusions: A two-way ANOVA found significant differences rooted in speaker type and condition. Typical speakers were rated higher in liveliness and comprehensibility. Aphasic speakers were rated higher in liveliness during the direct speech condition but lower than typical speakers overall in liveliness and comprehensibility. Relevance to current study: This study shows evidence that people with Broca’s and Anomic aphasia are perceived as less comprehensible than typical individuals/speakers when delivering narratives. However, it also suggests that using more direct speech could be a helpful strategy to increase the liveliness of their conversation and increase listener involvement and focus. The current study will focus more on how pause affects listener engagement and perception of the speaker.
Objective: To compare speakers with aphasia who also have apraxia of speech versus speakers with aphasia alone in two separate ways: (a) to see if their fluency indicators with cognitive-linguistic processing versus motor processing are different and (b) to examine the effect of cognitive load on fluency. Method: The experiment was conducted using 14 speakers with aphasia (seven of whom had additional apraxia of speech) and seven typical control speakers. The participants with aphasia were tested for speech and language capabilities using several standardized measures, including the *Western Aphasia Battery-Revised*. The clinicians also administered a motor speech evaluation to diagnose apraxia of speech and dysarthria. The participants were told to retell short stories after viewing them in audio and visual form in two different conditions: one in which there were no other cognitive tasks and one in which they were to distinguish between a high and low tone at the same time as they retold the story. Baseline for narrative retell and tone identification were taken and compared to the test results. After the narrative samples were collected, the researchers “analyzed [them] for speech fluency, speech rate, pause/fill time, and repetitions per syllable” using Praat. Conclusions: The researchers found that both groups of speakers with aphasia differed from the typical group, but they did not differ from each other considerably (other than more repetitions and longer samples from those with AOS during the narrative retell). All speakers with aphasia experienced less fluent speech output when they had to engage in simultaneous tasks and incorporated longer pauses. Relevance to current study: Like the researchers in this study, the current study is examining the fluency of speakers with aphasia. While this study
examined what factors/cognitive load influence fluency, the current study will be looking at how typical speakers perceive fluency in this population.


https://doi.org/10/1044/2019_JSLHR-L-18-0399

**Objective:** First, to determine how dual-task activities affect delivery speed, content accuracy and perceived effort when people with moderate, mild, or no aphasia tell narratives. Second, to look at the subjective reactions that come from telling a story while being asked to perform another task at the same time. **Method:** Two studies were conducted with different foci—the first study focused on quantitative measures and the second study focused on qualitative measures. Study 1 made up the experimental part of the study, where 33 participants were recruited in the categories of mild aphasia and moderate aphasia (n = 21), and neurotypical controls (n = 12). The participants with aphasia were divided into severity groups based on their language, communicative confidence, cognitive status, and working memory abilities as decided by several standardized tests including the *Western Aphasia Battery-Revised* (WAB-R). The control participants passed hearing and vision screenings and verified their “stroke-free status” using a questionnaire. The participants retold short stories as a singular task and while performing a concurrent task. Their responses were analyzed for speed (speech rate, pauses, repetitions), story retell accuracy, and perceived effort. In Study 2, the participants were recorded while reflecting on their experience and their performance during the two conditions. Their responses were transcribed and analyzed. **Conclusions:**
The participants with aphasia were affected more in their spoken language and emotional/behavioral reactions by the dual task than the participant controls. The different severity groups of aphasia demonstrated differing compensatory strategies—the participants with moderate aphasia kept up the same speed but declined in accuracy, while the participants with mild aphasia reduced their speed and kept the same accuracy. Both groups of participants with aphasia experienced negative reactions while faced with the dual task, but the group with mild aphasia was better able to implement strategies to maintain accuracy despite the increased cognitive load. Relevance to current study: This study demonstrates the impact that multi-tasking or outside distractions can have on the speech fluency and accuracy of people with aphasia. It gives evidence that dual tasks are especially challenging for people with aphasia. The participants with more severe aphasia were less able to compensate for the increased cognitive load and so were less accurate. The milder aphasic patients, however, implemented increased pausing and slowed speech rate to maintain accuracy. This increased pausing could be attributed to the increased cognitive load of the task, and that correlation is important to know as the current study examines the silent pauses in the speech of people with aphasia.


**Objective:** To gather evidence as to the effects of simulated speech fluency on listener perceptions of speakers with aphasia and to determine whether listeners perceive speakers with aphasia to be less favorable than neurotypical speakers. **Method:** 36 adult listeners (half of which were undergraduates from multiple major types aged 18-22 and
half of which were SLP grad students aged 22-40) rated nine audio samples (From the Aphasia Bank database; three of which contained unaltered aphasic speech, three of which contained simulated fluent speech, and three of which contained neurotypical speech). The samples of “simulated fluency” were created by altering the six audio samples from the speakers with aphasia. The non-simulated and simulated aphasic speech samples were placed in separate groups to avoid having the listener hear the same speaker in altered and unaltered states. The listeners rated the audio samples on how they perceived the speech, the speaker’s attributes, and their feelings about the audio samples. Examples of statements rated were, “I would feel comfortable having a conversation with this person,” “This person’s speech made me feel impatient,” or “I think this person is intelligent.” A mixed-effects ANOVA was then used to analyze their ratings.

Conclusions: The researchers found that the samples of neurotypical speech were rated more favorably than the samples of aphasic speech, and the modified samples of aphasic speech were rated more favorably than the non-modified samples. Ratings for speech intelligibility, ease of storytelling, intelligence, confidence, competence, and friendliness were negatively impacted for people with aphasia in comparison to neurotypical speakers. Listeners also reported feeling less patient, comfortable, and at ease when listening to people with aphasia. Interestingly, the graduate students in the study gave higher ratings for intelligibility, intelligence, and comfort in listening to PWA as compared to undergraduate students. Relevance to current study: This study gives evidence that speech fluency in people with aphasia affects listeners’ reactions and perceptions of them in a negative way. It is this exact vein of research that the current
study hopes to expand on further. Longer and more frequent pauses interrupt a speaker’s fluency and can impact the way they are perceived by others.


**Objective:** To perform a quantitative analysis of several cases relating to the “timing and construction” of responding actions, whether they be preferred or nonpreferred. The researchers sought to reproduce the results of past studies and find evidence to support that response timing reliably predicts whether it is preferred or nonpreferred. **Method:** The examiners looked at telephone conversations and the timing differences between 195 preferred and nonpreferred responding actions. They found that participants nonpreferred responses with turn transitions of 700 ms or more. They also found that preferred responses “come quickly and take simple forms” (256), while nonpreferred responses are often delayed and are more complex because they include “prefaces, qualifications, or accounts” (256). **Conclusions:** Because cognitive pause leads to prolonged pauses between responses and prolonged messages, persons with aphasia who experience cognitive pause may be perceived as transmitting nonpreferred or negative messages. Pauses of 600 ms or more tend to indicate nonpreferred answers, although the researchers found that nonpreferred answers could also follow shorter pause lengths (most normal acceptances and rejections were found to be within the window of 0 to 700 ms). The most important finding was that regardless of the positive or negative nature of the response, it was the pause length that determined whether the response was perceived as a preferred or nonpreferred “turn format.” **Relevance to current study:** The current study seeks to
quantify the point at which pause causes the listener to perceive that the speaker in a negative way. As such, the results of this quantitative analysis are highly pertinent.


**Objective:** To look at the strategies that observers/listeners will use to determine if someone is telling the truth or lying. **Method:** In the first study, the researchers simulated five job interview situations and had five male actors lie or tell the truth during the interview. 41 observers judged the actors’ truthfulness during these situations. In the second study, 74 participants listened to a simulated interview with a female applicant, where she answered a question (whether or not she smoked marijuana) with different pause lengths (one second vs. seven seconds) and answers (does or does not smoke) depending on the implicit opinion of the interviewer. The participants indicated their perceptions of her honesty after watching the video. **Conclusions:** Although the actors were consistently “good” or “bad” liars in the first study, the listeners did not always hit the mark in judging whether or not they were lying. The researchers found that the observers used the plausibility of the statement combined with latency/pausing and other factors (grooming, smiling, vagueness, posture) to determine whether the actor was lying. Long hesitations before an answer usually resulted in the listeners being suspicious as to the truth of the answer, especially when the answer was self-serving. Plausible answers with shorter hesitations usually resulted in the listeners believing the answer to be true. In the second study, listeners determined whether or not she smoked marijuana based mostly on her verbal answer. They used the idea of ulterior motive to judge whether or not the candidate was being honest (e.g., admitting that she smoked was seen as more
honest because it could lose her the job). The effect of pause in this study was that listeners tended to see it as an amplification of what the speaker said (if what the speaker said was suspicious, the longer (7-second) pause made it more so; if what they said seemed more truthful, the longer pause made it more so). Relevance to current study: Pausing was used in these studies as a key component in discovering whether or not a person was truthful. A longer pause tended to amplify the truth or lie of what was said. This is a perception that could possibly be applied to the pauses in conversation that are resultant of aphasia. The current study will explore this function of pause in more depth.


Objective: To continue research done about the impact of extralinguistic aspects of speech on perception of personality. The researchers focused on hesitancy (repetitions, silences) since that aspect had not been explored as often. Method: The researchers made taped speeches, one of which was “hesitant” and one of which was “non-hesitant.” The “hesitant” tape was extracted from a previous study and had a high rate of filled pauses, repetitions, and unfilled (silent) pauses. The “non hesitant” tape was the original “hesitant tape” with the pauses and repetitions spliced out or shortened. 40 male and 40 female university students were assigned to different tapes and rated the taped speech on a nine-point scale (ranging from “extremely uncharacteristic” to “extremely characteristic”). Trait adjectives like “sincere,” “interesting,” “finicky,” “annoying,” and 40 others were presented in random order to the participants. Conclusions: Non-hesitant speakers were generally rated more favorably than hesitant speakers. More of the desirable and positive adjectives were attributed to the non-hesitant speaker. The “hesitant” speaker was
expectedly rated as more hesitant and less fluent. **Relevance to current study:** This study demonstrates the effect that pause can have on how others perceive the personality of the speaker. In this study, it was shown to be a negative perception. The current study will investigate this line of study with the approach suggested at the end of the article--taking fluent speech and artificially inserting pauses.


**Objective:** To see if there is a relationship between cognitive processing and pauses during connected speech in typical aging adults and adults with Parkinson’s disease.

**Method:** The researchers measured the frequency of silent pauses and compared them to linguistic boundaries and language production proficiency measures. There was a total of 49 English-speaking participants, 15 of whom were young adults, 18 of whom were older adults, and 16 of whom were individuals with Parkinson’s disease. All the participants underwent a hearing screening and the *Cognitive-Linguistic Quick Test* to assess their cognitive status. Additional speech and language tests were administered to the typical and disordered adults in the study, and a severity rating of the participant’s speech production was collected. A Cinderella story was read to the participants and they were asked to retell the story. The participants who produced 10 or more silent pauses in their story qualified to be included in the data. Their recorded stories were analyzed for pauses (150 ms or longer), proportion of grammatically correct sentences, noun: verb ratio, clausal density, and percent of correct information units using Praat. **Conclusions:** Pause production during connected speech is reflective of cognitive processing for language
production. Atypical pauses were common among typical aging adults and those with Parkinson’s disease alike. *Relevance to current study:* This study addresses the important foundational principle that pause in speech is linked to cognitive functioning.


**Objective:** To examine pause, lexical variables, and production patterns among patients with primary progressive aphasia to better understand “the neuro-linguistic basis of word retrieval impairment” in patients with primary progressive aphasia. **Method:** After administering a wide range of preliminary standardized assessments, the researchers collected narratives from three groups of patients with PPA and a cognitively typical control group of 12 participants. The narratives were about the story of Cinderella. Word-finding pauses within these narratives were analyzed in terms of what type of word class the pause occurred near, how frequently they occurred, and how long they were. They also looked at the relationship between the occurrence of pause and cortical atrophy using MRI scans compared to the speech data. **Conclusions:** Atrophy in different brain regions can result in pauses occurring in different places. Those who paused more before nouns had “atrophy in the left precentral gyrus, inferior frontal gyrus and inferior parietal lobe,” whereas those who paused “before less frequent and longer words” had “atrophy in left precentral and inferior parietal regions” (Mack et al. 2015, p. 211, abstract). *Relevance to current study:* This study identifies the neurological genesis of pauses based on where and why those pauses occur in their speech production. Since the current study relates to
the effect of cognitive pause on speech production, it is important to understand the
cognitive roots of pause.

Oomen, C. C., & Postma, A. (2001). Effects of divided attention on the production of filled
pauses and repetitions. *Journal of Speech, Language, and Hearing Research, 44*(5), 997-
1004. https://doi.org/10.1044/1092-4388(2001/078)

*Objective:* To observe how the production rate of repetition and filled pauses is affected
by divided attention situations. *Method:* The researchers recruited 18 adults (university
students, 19-24 years old, native Dutch speakers) who had no history of disfluency and
had them perform a basic picture storytelling task. They did so under two conditions: one
which stood alone, and one which had the addition of performing a tactile-form
recognition task (feeling sandpaper figures and finding a certain one). The participants
first did a figures-only condition, then a speech-only condition, and then a divided
attention condition. The descriptions that the subjects provided during these tasks were
transcribed and analyzed. *Conclusions:* When the participants were in a divided attention
situation, they were found to have a greater frequency of filled pauses and repetitions.
The researchers observed that the divided attention task could affect the ease of speech
planning, which could explain why the subjects experienced increased disfluencies.

*Relevance to current study:* Speech disfluency and increased pausing is a common side
effect of aphasia because language processing centers are affected. When considering
disfluency in the context of therapy, clinicians must remember that disfluencies may
increase in situations where clients are required to attend to multiple things at once. This
may further affect others’ perceptions of PWA. Although this study discusses filled
pauses rather than silent pauses and tests typical speakers rather than speakers with
aphasia, it still lays a good groundwork for the relationship between pause and divided attention in typical speakers.


https://doi.org/10.1016/j.neuropsychologia.2018.12.018

**Objective:** To examine whether the type of discourse influences the process of pausing.

**Method:** The clinicians had 34 patients (17 with early AD and 17 controls) produce picture-based and memory-based narratives. These narratives were analyzed for pause duration and frequency using Praat software and were compared to each other. The clinicians examined the correlation between cognitive impairment and pause frequency.

**Conclusions:** Participants with AD and lexical-semantic decline demonstrated increased pausing during the picture-based narrative and unchanged pausing rates during the memory-based narrative. The researchers found that increased pause frequency was correlated with semantic fluency performance and grey matter density in the anterior temporal lobe (which is thought to be a crucial center for semantic memory and processing). Pausing was thought to reflect compensation for conversational deficits as caused by effects of the disease. **Relevance to current study:** While this study does not involve persons with aphasia, it does involve persons affected by cognitive decline. Persons with cognitive decline, and/or potential cognitive difficulties, such as persons with aphasia, may face correlated lexical-semantic decline which leads to the using of pauses as a compensatory strategy. The current study aims to determine how people who interact with persons with aphasia perceive this compensatory strategy.
http://doi.org/10.1121/1.4802900

**Objective:** To determine if there is a threshold of time after which negative social feelings are attributed to pause between speaker turns. **Method:** The raters consisted of 380 undergraduate students from ages 18-32, and they listened to six minutes of simulated telephone conversations among “friends relaxing at home.” Each brief conversation ended with a request or proposition, to which the response was “sure” after different amounts of time. Lag time of different lengths was perceptually rated in these exchanges on a Likert-type scale for “willingness” and “unwillingness” to “comply with requests.” The researchers used a between groups design and tested 100 ms intervals between 200 and 1200 ms. **Conclusions:** Raters tended to think that the response was negative after 600 ms, and there was a statistically significant difference in ratings when comparing 700 to 800 ms. The findings in this study confirmed prior research. **Relevance to current study:** The researchers will also be conducting perceptual ratings based on intervallic differences in pause, but our research will do so within the context of a sentence rather than the interlude between speaking turns.


**Objective:** To distinguish between cognitively healthy and cognitively impaired adults using pause and utterance duration data. **Method:** The researchers recruited 187 adults
from St. James’s Hospital and had them read an “emotionally neutral” story aloud. The adults were given the MMSE to assess their cognitive status. From these recordings, the researchers extracted the following features: “temporal features using a static 250 ms threshold, temporal features using a dynamic threshold, and pause and utterance duration distribution parameters.” A Linear Discriminant Analysis classifier was used to attempt to differentiate between cognitively healthy and cognitively impaired participants within each set. **Conclusions:** The classifier system performed the most accurately when given the pause and utterance duration distribution parameters set. The group with cognitive impairment had longer pauses and utterances than the healthy group. **Relevance to current study:** These researchers found that the presence of longer pauses can indicate cognitive impairment. The current study will look at how others perceive cognitive impairment/personal traits based on pauses.


**Objective:** To better understand the paralinguistic profile of confident versus doubtful speech. **Method:** The researchers recruited 47 undergraduate women at a local all-female teachers’ college and divided them into four groups. An actor recorded “linguistically confident” and “linguistically doubtful” versions of a legal defense using “para linguistically confident” and “para linguistically doubtful” speech. Those recordings were analyzed to see how long the pauses were in each type of discourse and what acoustic properties the recordings had. The participants listened to the recordings in random order and answered questionnaires rating the speaker’s confidence, expertise, and legal
competence on a scale of 0-100%. They then rated personality and speech attributes on a scale from 0-9. Conclusions: Acoustic analysis showed that the “confident voice” had greater energy, pitch, and rate compared to a “doubtful voice.” The “confident voice” also used fewer and shorter pauses. Two-way ANOVA and t-tests were used to analyze the rating provided by the students. Overall, they were able to correctly distinguish between “confident” and “doubtful” speech. The doubtful speech had more and longer pauses than the confident speech and was perceived as having different and often negative attributes compared to the more confident output. Relevance to current study: PWA often demonstrate longer and more pauses in their speech. This study shows how that could affect others’ perceptions of their confidence based on how pauses affect the perception of typical controls. PWA may be perceived as doubtful or as having a lack of confidence because of the pauses in their speech. The current study will further investigate this perception.


Objective: To analyze the linguistic repairs and “prepairs” (searching, pausing) of patients with aphasia compared to nonaphasic controls. Method: Six groups of 10 patients each were included in this study. The sample consisted of three aphasic groups (one with Wernicke’s, one with Broca’s, and one with amnesic aphasia). The three control groups were nonaphasic and consisted of one group with right hemisphere damage, one with left hemisphere damage (some of whom had aphasia but recovered), and one with no CNS involvement. The Aachen Aphasia Test was administered to all participants and the
results were analyzed. **Conclusions:** The group scores on the AAT from lowest to highest were Wernicke, Broca, Amnesic, LH controls, RH controls, and Normal controls. The researchers found that “prepairs” occurred more frequently than repairs (indicates impaired post articulatory monitoring) in patients with relatively good comprehension, poor production, or a mixture of both. There were few repairs in all groups; the four left hemisphere groups made significantly more “prepairs” than repairs (p < .006). **Relevance to current study:** This study gives more background information about the nature of pausing in patients with aphasia; that they pause most often when searching for words/recalling during speech, and this impacts their overall fluency. The word-finding difficulties/ hesitations that they experience were found to be largely a result of language processing problems.


**Objective:** To identify biomarkers that will predict speech fluency/language impairment severity after stroke and whether or not the patient might improve. **Method:** The researchers took previous research about the Arcuate Fasciculus lesion load (AF-LL; structural white matter) and compared it to functional gray matter lesion load (fGM-LL) (both systems being constructed from the speech of elderly controls) to see which system did a better job at predicting speech fluency and naming performance in patients. This comparison was done with a treatment group of 50 chronic stroke patients (at least six months post-stroke) and a control group of 24 age-matched healthy subjects (used to create “canonical functional and structural maps”). All of the participants in the treatment
group underwent language assessments and both groups underwent functional and structural MR imaging. The MRIs were assessed for lesion damage by a rater who was blinded to the outcomes behind each image. Lesion load was then calculated using the lesion maps. 

**Conclusions:** Both systems (AF-LL and fGM-LL) were able to predict speech fluency and naming ability on their own, and they did not predict the factors more accurately when combined. AF-LL was better able to explain variance and separate patients by whether their outcome was severe or not (96% accuracy for speech fluency, 90% accuracy for naming). 

**Relevance to current study:** The current study concerns the fluency/pausing rate of people with aphasia and how that affects the perceptions of others. This article discusses a means that is out there to determine what that fluency/naming ability will look like following a stroke that combines knowledge of lesion size and lesion site and how those factors affect pertinent anatomical structures. Looking at the arcuate fasciculus can be particularly helpful because it plays a key role in control of speech production, auditory-motor mapping, syntactic processing, comprehension, and perception. Looking at AF-LL is useful because it can predict speech fluency and naming ability and does not require more MR imaging than is usually done anyway post-stroke.


**Objective:** To look at pauses and timing structure in natural speech to better understand how speakers mark syntactic boundaries and the impact that it has on perceptual understanding of discourse. **Method:** Data was collected from publicly broadcast speech
samples and was segmented syllabically. The data was broken into different
segmentations (e.g., syllable, word, phrase) and boundary markers were found. Pauses
were categorized as to whether they indicated boundary markers or not (more often than
not they did, especially if the pause duration was longer). Conclusions: Appropriate pause
duration is an important contributor to natural-sounding and understandable speech.
However, other factors such as speaker, gender, rate, and speech style may influence the
boundary marking strength. Longer pauses generally indicate a boundary marker.
Relevance to current study: This study illustrates that longer pauses can indicate the end
of phrases or sentences. Patients with aphasia may find that their long pauses may cause
listeners to think that they are done speaking, and the listener may have a harder time
understanding the speech of the person with aphasia.
APPENDIX B

Informed Consent

Consent to be a Research Participant

Introduction
This study investigates how the characteristics of an individual’s speech impacts their ability to communicate effectively. This experiment is being conducted under the supervision of Shawn Nissen, Ph.D., an associate professor in the Department of Communication Disorders at Brigham Young University. You have been invited to participate because you are a native English speaker with typical hearing.

Procedures
Participation in this study will involve one visits of approximately one hour, which will take place in a research laboratory in the John Taylor Building at BYU. You will listen to a series of sentences and short conversations and rate each audio sample on how effectively it was communicated and your perceptions of the speaker’s personality in terms of likability, competence, and trustworthiness by using a computer mouse to select a rating button.

Risks/Discomforts
There are minimal risks for participation in this study. You may encounter some discomfort from wearing the over-the-ear headphones.

Benefits
There are no direct benefits to you. It is hoped this study will provide understanding in how to help individuals learn to communicate more effectively.

Confidentiality
All information provided will remain confidential and will be reported only as group data with no identifying information. All data, including records of your listening responses, will be kept on password-
protected computers in a locked laboratory and only those directly involved with the research will have access to them.

**Compensation**

You will be compensated $10 per hour for your participation.

**Participation**

Participation in this research study is voluntary. You have the right to withdraw at any time or refuse to participate without penalty.

**Questions about the Research**

If you have questions regarding this study, you may contact Shawn Nissen, Ph.D., at (801) 422-5056 or shawn_nissen@byu.edu.

**Questions about your Rights as Research Participants**

If you have questions regarding your rights as a research participant, you may contact the BYU IRB Administrator, A-285 ASB, Brigham Young University, Provo, UT, 84602 or at (801) 422-1461.

I have read and fully understand the consent form. Any questions have been answered to my satisfaction. I give my consent to participate in this research.

Signature: ____________________________________________  Date: _____________

Printed Name: _________________________________________
APPENDIX C

Pause Study Training Instructions

Prior to initiating the training stimuli, participants were given the following verbal instructions:

“You are going to listen to short and medium length speech passages. After you finish listening to a passage, you will rate how effective the speaker’s communication was and how likable they are based on their speech. Each passage does vary in length so please wait until the speaker is done talking before you push the submit button. We ask that you also base your rating solely on the speaker/passage you just listened to rather than comparing that passage to another passage you heard previously.”