The Influence of Pause on Listeners' Perceptions in Speech of People With Aphasia

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*Brigham Young University*

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The Influence of Pause on Listeners’ Perceptions in Speech of People With Aphasia

Emily Wright

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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The purpose of this study was to examine how varying pause lengths in speech of people with aphasia (PWA) influences listeners’ perceptions. The study specifically assesses listeners’ perceptions of communicative effectiveness and speaker likability. Speech samples from six people with nonfluent or fluent aphasia were obtained from a previous study conducted by Harmon (2018). The speech samples were modified to create four sets of stimuli, including the original recordings, normalized within utterance pauses, normalized between utterance pauses, and normalized for both within and between utterance pauses. Forty listeners rated each of the speech samples based on the perceived communicative effectiveness and likability using a visual analog scale. Communicative effectiveness and likability ratings were significantly higher for the normalized within utterance and normalized within and between utterance conditions when compared to the baseline and normalized between utterance conditions. Both male and female listeners rated the recordings from nonfluent aphasic speakers lower than recording from speakers with fluent aphasia. Results of the study provide preliminary evidence that pauses in speech of PWA influence listeners’ perceptions of communicative effectiveness and likability of the speaker. It is hoped that additional research regarding pause in speech of PWA will be conducted to determine if targeting pause in speech-language therapy will improve the communication of PWA.

Keywords: aphasia, pause, listener perceptions
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I am grateful for all of the support and assistance I have had throughout the course of this project. I would firstly like to thank my committee chair, Dr. Nissen for his direction, mentorship, and positive outlook throughout the process and completion of this study. I would also like to thank my committee chair members, Dr. Cabbage and Dr. Harmon, for their valuable insights, input, and feedback. I am also very grateful for the opportunity I had to work closely with Heidi McConaghie throughout this project. Her support, friendship, and hard work were invaluable throughout the process of this study. Lastly, I would like to thank my friends and family for their endless support and encouragement.
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DESCRIPTION OF THESIS STRUCTURE AND CONTENT

This thesis, *The Influence of Pause on Listeners’ Perceptions in Speech of People with Aphasia*, is part of a larger study exploring the impact of pause on speech communication in people 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, and the consent form used in this study is provided in Appendix B.
Introduction

An important aspect of speech is the use of pauses or short breaks of silence between words, phrases, sentences, or sections of a discourse. In typical speech, pauses occur at different locations within an utterance or conversation and are of varying duration. Despite the frequent use of pauses in speech, the amount of literature on pause is limited in relation to other areas of spoken communication. Because pause is such an integral part of spoken communication, it is important to more fully understand how it is used by speakers to efficiently and accurately communicate with others.

Communicative Functions of Speech Pause

One function of speech pause is to allow time for a speaker to cognitively plan and organize their speech output (Goldman-Eisler, 1958). Thus, pause in speech may be termed a “cognitive pause,” due to the cognitive planning and processing that takes place during these short interruptions. Silent pauses are characterized by silent or empty intervals during speech, whereas “filled pauses” contain vocalizations that do not have lexical meaning (Esposito et al., 2007). During these various types of speech pause, an individual has time to cognitively process and access words and vocabulary in their mental lexicon (Hartsuiker & Notebaert, 2009). Additionally, after accessing the needed words and vocabulary, an individual has time to formulate syntax. Pauses also allow time for an individual to construct a motor plan for speech (Kircher et al., 2004).

Speech pauses are not only used by speakers to gain time to cognitively process language, but also for important linguistic functions of spoken communication. For example, pause assists in conveying discourse cues. Engaged and active listeners and conversation partners rely on pauses, although often without conscious awareness, to determine when to take a
speaking turn and when to change topics (Roberts & Kirsner, 2000). Another function of pause is to help listeners segment linguistic units. Yang (2004) found that duration of pauses is correlated with boundary status in speech, allowing listeners to create phrasal boundaries and segment units of speech. Another linguistic function of pauses is to help facilitate categorization and recall. For example, in a study conducted by Reich (1980), individuals were able to categorize words more rapidly and recall propositions more accurately in sentences with pauses between clauses rather than within clauses. Overall, pauses are significant as they have many necessary functions for successful communication between conversation partners.

**Atypical Patterns of Speech Pause**

Considering that pauses in speech are used to achieve a number of cognitive and linguistic functions in typical speech, atypical patterns of pause may negatively impact communication. Atypical patterns of pause may not only result in speech production difficulties for the speaker, but also have detrimental effects on speech perception for the listener. MacGregor et al. (2010) examined the consequences of silent pauses for listeners through results of electrophysiological data. For utterances with an atypical silent pause, unpredictable target words correlated with delayed left frontal lobe activity in the brain. Therefore, brain activity was not as rapid as expected for utterances with atypical pause. Results indicate that silent pauses may interrupt comprehension for listeners. Listeners also have more difficulty categorizing words when pauses are inserted in nongrammatical locations (Reich, 1980). These findings support the concept that atypical pauses are disadvantageous for listeners’ understanding of a speaker’s message.

Atypical pause in an individual’s speech may be caused by developmental disorders or fluency disorders (Gong et al., 2016; Prasse & Kikano, 2008). In addition, difficulty in producing
appropriate pauses in speech can also be the consequence of neurophysiologic damage or disease resulting in cognitive impairment. One cognitively impaired population that may have difficulty producing effective patterns of speech pause are individuals with dementia. A study conducted by Rochford et al. (2012) investigated how pause and utterance duration is used by communication specialists to differentiate between neurotypical and cognitively impaired older adults. According to Rochford et al. (2012), pause duration parameters may classify individuals based on their cognitive function. They found that cognitively impaired participants generated more pauses that were greater than 250 ms than the healthy group; for pauses greater than 250 ms, the cognitively impaired group had an average of 28.76 number of pauses compared to 24.01 pauses for the typical individuals during a short two-to-three-minute speech reading task. Additionally, in comparison to typical individuals, cognitively impaired individuals paused 6.5 seconds more during the speech task on average.

Another population that may exhibit atypical pause in their speech communication is individuals with a history of traumatic brain injury. Peach (2013) found that nonaphasic individuals with severe brain injury had more pauses in comparison to non-brain injured adults. In the study, 100% of speakers with TBI produced at least one pause greater than 200 ms during their narrative, while only 83% of the speakers in the control group produced a pause greater than 200 ms. Additionally, the number of pauses used was greater for individuals with TBI, ranging from 1 to 19, than for controls, ranging from 0 to 6. Pause patterns may also be impacted in individuals with Parkinson’s disease. More pauses in utterances are used by individuals with Parkinson’s disease in comparison to typical controls (Smith et al., 2018). Further research has also reported on pause measures for individuals with amyotrophic lateral sclerosis (ALS). In a study by Barnett et al. (2019), measures of pause were able to distinguish individuals with ALS
even at the presymptomatic and early stages of the disease. For example, in comparison to controls, individuals with pre-symptomatic and symptomatic ALS had slower speaking rates, more pause events, and longer mean pause lengths. These studies show that differentiation of pause length in speech may be beneficial in the assessment of communication deficits caused by neurological diseases, such as dementia, traumatic brain injury, Parkinson’s disease, and amyotrophic lateral sclerosis.

Aphasia is another disorder that results from neurophysiological damage and specifically affects language functioning. A few studies have been conducted examining pause for people with aphasia (PWA) and have found that these individuals often have atypical speech pauses in comparison to typical individuals. For example, in a study conducted by Angelopoulou et al. (2018), researchers examined pause and its association with various linguistic elements in aphasia including utterances, nouns, noun phrases, verbs, and paraphasias. Results of the study concluded that there were different thresholds of pauses for the control group and the group of PWA. Pauses were associated with various linguistic elements and impacted the temporal organization of speech for the individuals with aphasia. For example, PWA produced both more short (<200 ms) and long (>2000 ms) pauses within utterances than controls. They also produced significantly more long pauses between utterances than controls. PWA also produced more short pauses before nouns than the neurotypical individuals. A recent study by Dede and Salis (2020) examined the temporal and episodic organization of discourse production for PWA. They found that individuals with aphasia had longer silent pause durations and slower speech rates than the control group. Similarly, Deloche et al. (1979) found that pause length is increased for individuals with aphasia, therefore impacting verbal rate. Overall, studies examining the use of
pause for PWA have found that these individuals often have longer pauses in speech. This may be connected to both the cognitive and language deficits that are seen in PWA.

**Listeners’ Perceptions Based on Pause in Speech**

It is important to consider the effects that pause has on listeners’ perception of the speaker and their ability to comprehend the intended message. Individuals may view speakers differently based on their use of pauses in speech. For example, Lay and Burron (1968) examined how individuals rated personality based on the effects of hesitations in speech. Listeners rated speakers based on 15 desirable traits (e.g., sincere, intelligent, reliable), 14 neutral traits (e.g., normal, talkative), and 15 low desirable traits (e.g., conceited, annoying). As a whole, participants rated speakers without hesitant pauses with more favorable trait adjectives than the speakers with hesitations or pauses in speech. Further examination of perceptions of speakers was conducted by Scherer et al. (1973). They examined listeners’ perception of speakers’ confidence and found that individuals rated speech samples with shorter pauses as more confident. Another perceptual study by Brennan and Williams (1995) evaluated listeners’ perceptions about the metacognitive states of speakers based on fillers, latency, and prosodic intonation. For longer pauses in speech, participants gave lower ratings of how well they felt the speaker knew the answer to what they were speaking about. Therefore, this study showed that pause has an influence on individuals’ perceptions of others (in regard to the speaker’s knowledge). Generally, the findings reported by previous research have indicated that the patterns in speech pause influence how listeners perceive the accuracy of the expressed message and even the competence of the speaker. When speakers exhibit more frequent and extended pauses, listeners often perceive them as having fewer preferred personal qualities. These
perceptual biases can significantly impact a PWA’s communicative, social, and occupational functioning.

Only a small amount of preliminary research has been conducted to determine listeners’ perceptions of PWA. For example, Croteau and Le Dorze (2001) examined spouses’ perception of PWA. According to Croteau and LeDorze (2001), PWA were perceived more negatively by their spouses than typical controls. Another more recent study by Groenewold et al. (2014) considered the perceived liveliness and speech comprehensibility for PWA. This study focused on the use of direct speech constructions in narratives and found that aphasic speakers were rated less lively than typical speakers. Additionally, PWA were less understood by listeners in comparison to controls. Harmon et al. (2016) aimed to determine if listeners perceive speakers with aphasia to be less favorable than neurotypical speakers. Speech samples by neurotypical adults were rated more favorably than aphasic speech samples. These studies show PWA are perceived less favorably based on speech, however the specific characteristics of speech that cause these perceptions are unclear.

While there is some research regarding listeners’ perceptions of aphasic speakers (Croteau & Le Dorze, 2001; Groenewold et al., 2014; Harmon et al., 2016), little research has looked specifically at the influence of pause length on listeners’ perceptions of PWA. Thus, the purpose of the current study is to provide empirical data about how pause in the speech of PWA affects listeners’ perceptions of communicative effectiveness and likability. This study will specifically evaluate the following research questions:

1. How do listeners perceive the communicative effectiveness of speech from PWA with differing degrees of pausing within and between utterances?
2. How do listeners perceive the likability of PWA with differing degrees of pausing within and between utterances?

Method

The data collected and analyzed in this thesis are part of a joint research project exploring the acoustic and perceptual characteristics of speech pause for PWA (McConaghie, 2021). Additionally, aphasic speech samples used in data collection for this joint project were acquired from a larger research project (Harmon, 2018).

Listeners

Speech recordings from PWA were evaluated and rated for communicative effectiveness and likability by 40 English speaking listeners. Participants were recruited by word of mouth. Participants included some undergraduate students in the BYU Communication Disorders Department while some had no connection to the department. The group included 24 female and 16 male adult listeners between 18 and 65 years of age. Prior to participating in the research study, participants completed a consent form and passed a hearing screening. The hearing screening consisted of a pure-tone air conduction evaluation at 25 dB HL at the frequencies of 1,000, 2,000, and 4000 Hz. This research project and its procedures were approved by the Institutional Review Board at Brigham Young University.

Stimuli

Speech recordings evaluated in this study were obtained from a previous study conducted by Harmon (2018). Recordings were produced by six people classified as having mild or moderate aphasia according to results of the Western Aphasia Battery. The recordings by the PWA were obtained during a narrative retell task. In most cases, the beginning segment of each recording was selected for use in the study. However, a later segment of the recording for the
aphasic speaker four was used due to the presence of profane language. The aphasic speakers with Broca’s aphasia had comorbid apraxia of speech. Detailed information about the demographics of the speakers and the speech samples used in this study can be found in Table 1.

**Table 1**

*Demographic and Speech Sample Information of PWA*

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Aphasia Type</th>
<th>Aphasia Sub-Type</th>
<th>Aphasia Severity</th>
<th>Total Number of Utterances</th>
<th>Total Number of Words</th>
<th>Total Number of Syllables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>59</td>
<td>Fluent</td>
<td>Anomic</td>
<td>Mild</td>
<td>19</td>
<td>232</td>
<td>272</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>65</td>
<td>Fluent</td>
<td>Anomic</td>
<td>Mild</td>
<td>26</td>
<td>213</td>
<td>257</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>61</td>
<td>Nonfluent</td>
<td>Broca’s</td>
<td>Moderate</td>
<td>12</td>
<td>99</td>
<td>118</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>60</td>
<td>Fluent</td>
<td>Anomic</td>
<td>Moderate</td>
<td>17</td>
<td>106</td>
<td>171</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>56</td>
<td>Nonfluent</td>
<td>Broca’s</td>
<td>Moderate</td>
<td>15</td>
<td>95</td>
<td>129</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>48</td>
<td>Nonfluent</td>
<td>Broca’s</td>
<td>Moderate</td>
<td>6</td>
<td>59</td>
<td>104</td>
</tr>
</tbody>
</table>

Each of the 6 sample recordings were evaluated under four different stimulus conditions to create a total of 24 different speech recordings of approximately 30 seconds in duration. The first stimulus condition or set of recordings rated by the listeners was the unmodified speech recording produced by the aphasic speakers. For the second stimulus condition, the Praat Acoustic software program (Boersma & Weenink, 2021) was used to normalize pause lengths within utterances to patterns reflective of a typical speaker. For a visual of the Praat Acoustic software program see Figure 1. The “typical” within utterance pause lengths were obtained by averaging the pause lengths produced by three speakers without aphasia reading transcripts of the original samples from PWA. The transcripts included identical language and speech present in the original samples from PWA. The same aphasic speech samples were modified for pause length in order to control for syntax, vocabulary, articulation, and other factors that may influence listeners perceptions of the speaker. The third condition normalized pauses between
utterances in the same manner. The final condition normalized both within and between utterance pauses to simulate pause for a typical speaker at both the within and between utterance level. In each of the modified conditions, normalization of pauses included both silent and filled pauses.

**Figure 1**

*Praat Acoustic Software Program Analysis*

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**Procedures**

After qualifying to participate in the study by signing a consent form and passing a hearing screening, participants were asked to listen to and evaluate the speech stimuli of the four stimuli conditions. Participants were provided with an overview of the study and informed that they would hear speech samples of varying lengths and then rate the samples based on their perception of the speaker’s effectiveness of communication and likability.
Prior to data collection, listeners participated in an approximately five-minute training session to familiarize them to the listening task. For the training, participants listened to trial speech recordings through loudspeakers and were instructed to rate the recording through use of a visual analog scale on a computer desktop. After completing the training, participants then began the study and were presented the stimuli randomly. Participants listened to stimuli in a double-walled sound booth while seated in front of the computer. The stimuli were presented through loudspeakers at approximately 60 dB. However, participants were permitted to adjust the volume level at their own discretion within safe hearing limits.

Listeners rated their perceptions of the speaker recordings using a visual analog scale for the traits of communicative effectiveness and likability. As shown in Figure 2, the visual analog scale was presented via a custom computer program, consisting of a slider bar with a continuum of qualitative categories ranging from “very good,” “good,” “average,” “poor,” to “very poor.” Prior to statistical analysis, the continuous ratings were converted to a scale of 0 – 100. After completing their rating for each stimulus item, the listeners were instructed to submit their rating and proceed to the next speech stimulus recording by clicking with the computer mouse. Participants were instructed to listen to the full speech sample prior to completing their ratings. Participants were also instructed to rate speech samples solely on the recording heard and not compare the recordings to those listened to previously. One hundred and twenty-six foil speech samples were randomly incorporated among the speech stimuli for a total of 150 samples for the entirety of the study. Foils were produced by typical speakers and consisted of simple sentences with a subject-object-verb format of approximately three seconds in length. Ratings for the foil stimuli were not included in the analysis for this study.
Statistics

Descriptive statistics of mean, standard deviation, and range were reported for the dependent variables. A mixed-model repeated measures analysis of variance (ANOVA) was performed to analyze these data with a between-subjects factor of listener gender and the within-subject factors of stimulus condition and aphasia type. The ANOVA results include a measure of effect size, partial eta squared ($\eta^2$). The dependent variables evaluated were listener ratings for communicative effectiveness and likability.

Measurement Reliability

To inspect reliability of the listener ratings in this study, 20% of the stimuli were randomly rated a second time by each participant. For communicative effectiveness, the first and second sets of ratings had a Pearson correlation of $r = .71$, $p < .0001$, with a mean absolute
difference of 8.25 on a scale of 0 – 100. For likability, the sets of ratings were correlated at $r = .80, p < .0001$, with a mean absolute difference of 9.58 on a scale of 0 – 100.

**Results**

This study was part of a larger project designed to evaluate the effects of listeners perception of both atypical and aphasic speakers based on differing pause lengths in speech (McConaghie, 2021).

**Communicative Effectiveness**

**Listener Gender**

Listener ratings for communicative effectiveness were not found to differ significantly as a function of listener gender (female $M = 27.7$, male $M = 23.5$).

**Stimulus Condition**

The ANOVA indicated a significant main effect of stimulus condition for the listener ratings of communicative effectiveness, $F(3,114) = 22.51, p < 0.0001, \eta^2_p = 0.372$. As shown in Figure 3, the baseline condition ($M = 22\%$) and normalized between utterance condition ($M = 23\%$) were rated significantly lower than both the normalized within utterance condition ($M = 29\%$) and normalized within and between utterance condition ($M = 28\%$). No other interactions were found to be significant. A detailed listing of listener ratings for communicative effectiveness can be found in Table 2.

**Aphasia Type**

Additionally, the ANOVA indicated a significant main effect of aphasia type, $F(1,38) = 166.17, p < 0.001, \eta^2_p = 0.814$ and a two-way interaction between aphasia type and listener gender, $F(1, 38) = 4.43, p < 0.042, \eta^2_p = 0.104$. As illustrated in Figure 4, the nonfluent aphasic type were rated significantly lower than the fluent aphasic type by both males (nonfluent $M =$
Figure 3

*Mean Listener Ratings for Communicative Effectiveness and Likability by Stimulus Condition*

![Bar chart showing mean listener ratings for communicative effectiveness and likability by stimulus condition.](Image)

Figure 4

*Mean Listener Ratings of Communicative Effectiveness for Listener Gender and Aphasia Type*

![Bar chart showing mean listener ratings of communicative effectiveness for listener gender and aphasia type.](Image)
**Table 2**

*Listener Ratings of Communicative Effectiveness Across Listener Gender, Aphasia Type, and Stimulus Condition*

<table>
<thead>
<tr>
<th>Listener Gender</th>
<th>Aphasia Type</th>
<th>Stimulus Condition</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (n=24)</td>
<td>Fluent</td>
<td>1</td>
<td>35.2</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>43.8</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>34.4</td>
<td>10.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>42.5</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>Non Fluent</td>
<td>1</td>
<td>13.1</td>
<td>9.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>18.3</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>15.3</td>
<td>10.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>18.7</td>
<td>11.1</td>
</tr>
<tr>
<td>Male (n=16)</td>
<td>Fluent</td>
<td>1</td>
<td>25.7</td>
<td>19.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>37.1</td>
<td>22.8</td>
</tr>
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<td>3</td>
<td>30.3</td>
<td>19.1</td>
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<td>33.5</td>
<td>21.2</td>
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<td>Non Fluent</td>
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<td></td>
<td></td>
<td>3</td>
<td>12.4</td>
<td>9.2</td>
</tr>
</tbody>
</table>
normalized between utterance condition 3 ($M = 44\%$) was rated significantly lower than the normalized within and between utterance condition 4 ($M = 47\%$). No other interactions were found to be significant. A detailed listing of listener ratings for likability can be found in Table 3.

**Aphasia Type**

The ANOVA also indicated a significant main effect of aphasia type, $F(1, 38) = 38.395$, $p < 0.0001$, $\eta^2_p = 0.503$. As illustrated in Figure 5, nonfluent ($M = 40\%$) aphasia type was rated significantly lower than fluent ($M = 51\%$). No interactions were found to be significant.

**Table 3**

*Listener Ratings of Likability Across Listener Gender, Aphasia Type, and Stimulus Condition*

<table>
<thead>
<tr>
<th>Listener Gender</th>
<th>Aphasia Type</th>
<th>Stimulus Condition</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (n=24)</td>
<td>Fluent</td>
<td>1</td>
<td>37.0</td>
<td>22.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>51.1</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>50.3</td>
<td>16.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>53.6</td>
<td>16.9</td>
</tr>
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The overall purpose of the current study was to provide empirical data about the implications of pause in the speech of PWA for listeners. The study examined how pause length in speech of PWA influences listeners’ perceptions. More specifically, the study examined the factors of communicative effectiveness and speaker likability for varying pause lengths in aphasic speech.

The first aim of the current study was to examine how listeners perceive the communicative effectiveness of speech from PWA with differing degrees of pausing within and between utterances. As could be expected, results of the study revealed that listeners rated communicative effectiveness lowest for the baseline condition in which the pause lengths were
not normalized. When within-utterance, between utterance, and both within and between utterance pauses were normalized for typical speech, listeners’ ratings for communicative effectiveness improved. The results and ratings were determined to be significantly higher for the normalized within utterance condition and normalized within and between utterance condition compared to the baseline and normalized between utterance condition. These results seem to indicate that listeners perceptions of a PWA’s communication is more impacted by extended pause within an utterance and only minimally affected by between utterance pauses. However, additional normative data about the characteristics of typical patterns of both within and between utterance pause lengths is needed to make a comparison to those speakers exhibiting disordered speech.

This finding supports the claims of MacGregor et al. (2010) and Reich (1980) who found that pauses may interrupt comprehension and be disadvantageous for listeners’ understanding and comprehension of the speaker’s message. However, unlike the current study, the methods of MacGregor et al. (2010) and Reich (1980) did not include perceptual results from listeners and did not specifically examine pauses in PWA. However, according to the current study, their claims are supported and may translate to people with aphasia. Similar to the results of the current study, Groenewold et al. (2014) also found that PWA were less understood than controls. Although, Groenewold et al. (2014) did not specifically examine differences based on pauses in speech, the current study supports the rationale that atypical pauses may be a significant factor in why listeners perceive aphasic speakers’ messages as less effective.

Results of the current study also revealed that communicative effectiveness was rated significantly lower for nonfluent aphasic speakers than fluent speakers by both male and female listeners. As supported by Feenaughty et al. (2021), nonfluent aphasic speakers produce longer
silent pauses than fluent aphasic groups. Therefore, the increased atypical pause in nonfluent aphasic speakers may more negatively impact listeners’ perceptions of communicative effectiveness in comparison to fluent aphasic types. However, the current study is limited in addressing differences between aphasia types as the rated aphasic speakers only included one subtype of nonfluent aphasia (Broca’s) and one subtype of nonfluent aphasia (anomic). Future studies should include additional subtypes of both non-fluent and fluent aphasia types to further examine the effect of listeners’ perceptions of pause on aphasia type. Additionally, it is important to note that all nonfluent aphasic speakers had a severity rating of moderate, while two of the fluent aphasic speakers had a severity rating of mild and only one fluent aphasic speaker had a rating of moderate. Therefore, ratings may have been lower in the nonfluent type due to increased severity in comparison to the fluent type. Future studies should control for this effect by examining differences based on aphasia type in groups with matching severity levels.

The second aim of the current study was to examine how listeners perceive the likability of PWA with differing degrees of pausing within and between utterances. Results of the study showed that individuals rated likability in the baseline condition lower than all other conditions with normalized pauses. However, only the normalized between utterance condition was rated significantly lower in likability than the normalized within and between utterance condition. Therefore, individuals perceived the aphasic speaker as significantly more likable when there were typical pauses within and between utterances than when typical pauses were only in between utterances. It was suspected that more significance would have been present for differences in the baseline condition in comparison to all other conditions, rather than only significant differences in the between utterance and within and between utterance conditions. However, the results still support the notion that the presence of more typical pauses in speech,
such as in both within and between utterances, improve listeners’ ratings of likability in comparison to the presence of more atypical pauses, such as only normalized between utterance pauses. This finding is supported by Lay and Burron (1968), who found that subjects rated speakers without hesitant pauses with more favorable trait adjectives. Lack of significance between all conditions in the current study may have been due to the limited amount of aphasic speech samples used in the study. Future studies should use a greater number of aphasic speech samples for a more comprehensive evaluation of differences for normalized between, within, and both within and between utterance pauses.

The current study also revealed that listeners rated likability significantly lower for the nonfluent aphasic type in comparison to the fluent aphasia type. Although Lay and Burron (1968) did not examine differences between aphasia types, because nonfluent aphasia type has increased pauses in comparison to fluent aphasia types, it would be suspected that nonfluent aphasic speakers would be rated less favorably than fluent aphasic speakers (Feenaughty et al., 2021). As mentioned prior, the current study is limited in subtypes of both nonfluent and fluent aphasia, and further studies should assess these differences between aphasia types. Additionally, the differences in severity levels in aphasia types may have influenced ratings. Therefore, further research in regard to listeners’ perceptions based on aphasia type is warranted.

As stated above, there are a number of limitations to the current study. This study only evaluated speech recordings from a relatively small number of speakers with only two subtypes of aphasia. Additionally, the six aphasic speakers who produced the speech recordings were all categorized as having mild or moderate aphasia. Future studies should include and compare differences between mild, moderate, and severe aphasia types in addition to using more aphasic speakers and speech samples. Additionally, although the speech samples being rated were
randomly separated by recordings of “foil” speech samples, listeners’ ratings may have been influenced by hearing multiple versions (across the four conditions) of the same recordings a number of times. Future studies should attempt to reduce the influence of repeated utterances by including additional foils or increasing the amount of time between rating similar stimuli in various pause conditions. It would also be beneficial if foils were more similar to the evaluated stimuli.

Despite these limitations, this study provides preliminary evidence that pauses in speech of PWA influence listeners’ perceptions of communicative effectiveness and likability of the speaker. Therefore, it may be beneficial in speech-language therapy to train caregivers and communication partners to allow PWA additional time in spoken communication to account for atypical pauses without interruption. Increased awareness of pauses in speech of PWA by listeners may improve their perceptions of PWA and improve communication. Additionally, as between utterance pauses had less of an effect on listener perceptions than within utterance pauses, it may prove beneficial to target reducing within utterance pauses in speech-language therapy rather than focusing on between utterance pauses. However, it may be difficult to completely reduce pause in speech of PWA due to the added processing time required for speech and language output. Therefore, perhaps training PWA to strategically shift pausing to the between utterance position rather than the within utterance position may improve listeners’ comprehension of the intended message and perceived likability of the speaker.

It is hoped that the findings of this study will instigate additional research in regard to listeners’ perceptions of pause in speech of PWA. It is important to consider listeners’ perceptions of people with aphasia as these individuals often have difficulty returning to functional life and receiving the needed support from others after their initiating injury.
further information and research regarding the effect of pause on listeners’ perceptions, it can be
determined if targeting pause in speech-language therapy will prove to be a beneficial and
functional goal for PWA. It is hoped that additional insight in this area will assist PWA to
improve their communication and quality of life.
References


APPENDIX A

Annotated Bibliography


**Objective:** The purpose of this study was to examine pause it how it associated with various linguistic and variable elements in aphasia. **Method:** Speech samples from 18 individuals with aphasia due to left hemisphere stroke and 19 controls were taken and transcribed. Language elements and pauses in the speech samples were analyzed using the EUDICO Linguistic Annotator (ELAN) professional annotation tool. Each pause was annotated to determine its relation to utterances and what followed each pause examining various linguistic elements. **Conclusions:** Results of this study conclude that there are different thresholds of pauses for the control group and the group of individuals with aphasia. Longer pauses were associated with various linguistic elements and indicate that cognitive processes are significant for sentence planning. **Relevance to current study:** This study is significant for the current as it shows that cognitive processes impact the temporal organization of speech specifically with individuals with aphasia. The pauses and changes in linguistic elements may impact how individuals perceive speech, which will be examined in the current study.

Objective: The purpose of this study was to determine how pause, speed, and repair phenomena contribute to a subjective rating of fluency and how sensitive individuals are to these factors perceptually. Method: Speech samples of various speaking tasks were obtained from which objective acoustic measures were calculated. The first group of participants judged speech sample fragments to determine the overall fluency based on pauses, speed, and use of hesitations and/or corrections. Three other groups of participants rated the speech samples based either on pauses, speed, or use of hesitations and corrections with no reference to fluency. Conclusions: Results of this study show that participants responses to fluency were mainly influenced by pauses and speed rather than by repairs. Relevance to current study: This study is significant for the current study as it shows that pause contributes to individual’s perception of how fluent speech is. As the current study deals with perceptual ratings of pause, it is important that pause contributes to perceptual ratings of speech fluency as supported by this study.


Objective: The purpose of this study was to examine the contribution of fillers, latency, and prosody/intonation in how listeners interpret utterances. Method: This study included three experiments. In the first experiment, subjects answered questions. Their responses were recorded, transcribed, and latencies and intonation patterns were measured and analyzed. Subjects also rated their “feeling of knowing” (FOK) on a 1-7 scale on whether they thought they could recognize the answer in a multiple-choice test. They then took a multiple-choice test to determine if they were able to recognize answers. In experiment
two, subjects listened to recorded answers and nonanswers to questions. On a 1-7 scale, they rated answers from incorrect to correct and nonanswers based on if they thought the recorded individuals could recognize or not recognize the answer on a multiple-choice test for a “feeling of another’s knowing” (FOAK) rating. They also rated their own FOK for questions. Experiment three followed the same procedure as experiment two with the addition of varied latency and fillers within items. Conclusions: Results of the first experiment show that individuals have metacognitive knowledge about their latency and intonation of responses. Results of the second and third experiments showed that listeners feeling of another’s knowing was affected by intonation, form of nonanswers, latency, and fillers. Longer pauses led to a lower rating of “feeling of another’s knowing” (FOAK) than shorter pauses in answers. Overall, FOK and FOAK were negatively correlated with latency or pauses in answers and positively correlated with latency to nonanswers. Relevance to current study: This study showed that pause has an influence on individual’s perceptions of others (in regard to their knowledge of answers). The current study will likewise examine the perceptual effects of pause with a focus on individuals with aphasia.


*Objective:* The objective of this study was to examine if people with aphasia are perceived differently by their spouses in comparison to how typical speakers are perceived by their spouses. *Method:* Participants with aphasia were measured for functional ability through the Functional Status Index. Spouses of people with and without aphasia described their spouses using the Adjective Check List. Spouse’s responses were analyzed to describe
the relationship between aphasia and spouse’s perceptions of these individuals.

**Conclusions:** Results of the study show that people with aphasia were rated differently than people without aphasia by their spouses. Overall, people with aphasia were perceived more negatively than controls. This was seen especially in regard to endurance and achievement. **Relevance to current study:** Like this study by Croteau and Le Dorze (2001), the current study will also examine perceptual characteristics of aphasic speech. However, the current study will not only focus on overall speech, but the impact of pause on perceptions of speech in individuals with aphasia based on speech samples.


**Objective:** The purpose of this study was to examine the temporal and episodic organization of discourse production for individuals with latent aphasia. The objective is to investigate if these linguistic and psycholinguistic processes differentiate individuals with language difficulties such as those with latent aphasia from those who do not.

**Method:** Three groups including neurotypical adults, individuals with latent aphasia, and individuals with anomic aphasia retold the Cinderella story. Audio files and transcriptions of story retells were coded and segmented. Researchers calculated the number of words, total durations of narrative, silent pause durations, articulation durations, pure word durations were measure, formulation time measures, and episode recurrence indexes. Data was then analyzed. **Conclusions:** Results of the study showed that individuals with latent aphasia had longer silent pause durations and slower speech rates than the control group. However, other temporal measures did not distinguish people with latent aphasia
from neurotypical controls. Additionally, the results showed that individuals with latent aphasia had longer processing speeds. **Relevance to current study:** This study is relevant to the current study as it shows that individuals with latent aphasia have longer silent pause durations. The current study will investigate the perceptual effects of silent pause durations in individuals with aphasia.


**Objective:** The purpose of this study was to examine how phonation rate, number of silent pauses, and mean duration of silent pauses play a role in variations of verbal rate in individuals with aphasia and analyze how variations relate to disturbances in speech production processes. **Method:** Speech samples from five patients with aphasia were obtained through interview and a picture description task. Variables were calculated and analyzed and compared to between tasks and compared with controls. **Conclusions:** Overall, phonation rate and mean duration of pauses had a notable impact on verbal rate, while the total number of pauses had a lesser effect on verbal rate. Therefore, the mean duration of pauses plays a more significant role in verbal rate than the number of pauses. **Relevance to current study:** This study is relevant to the current study as both studies examine pause in individuals with aphasia. This study shows that pause is increased and has an impact on verbal rate in individuals with aphasia which may affect listener’s perceptions, which will be examined in the current study.
Objective: The purpose of this study was to examine the effects of direct speech constructions (use of quotations) on perceived liveliness and comprehensibility of aphasic speech. Method: Thirty speech samples from 10 aphasic and 10 no brain-damage individuals with and without direct speech constructions were used from a previous study. Raters scored liveliness and comprehensibility of what they heard after each speech fragment and results were analyzed. Conclusions: Typical speakers were rated higher in liveliness than aphasic speakers. Use of direct speech constructions was rated as livelier in both types of speakers. Individuals with aphasia had lower comprehensibility scores. Direct speech constructions had no effect on comprehensibility. Relevance to current study: Overall, this study showed that for individuals with aphasia, messages in narratives are perceived as less comprehensible than typical individuals/speakers. The current study will also examine perceptual features of aphasic speech with a focus on pause.


Objective: The purpose of this study was to determine if indicators of speech fluency are different between speakers with aphasia concomitant with apraxia of speech and speakers
with aphasia only. Additionally, the study explored if cognitive load reduces fluency in these speakers. **Method:** Researchers obtained narrative samples from seven individuals with aphasia and seven neurotypical controls. They also obtained narrative samples while the individuals were distinguishing between high and low tones to increase cognitive load. The samples were then analyzed based on duration, rate, pause/fill time, and repetitions per syllable as features of fluency. **Conclusions:** Individuals with aphasia were less fluent than the controls. When completing the dual task, all groups had longer pauses and fillers. The control group also showed reduced speaking rate. Overall, speech is less fluent when individuals are completing more than one task. **Relevance to current study:** This study is related to the current study as they both examine pause in individuals with aphasia. Additionally, the study supports the idea that pause is an indicator of speech fluency.


http://dx.doi.org/10.1080/02687038.2015.1077925

**Objective:** The purpose of this study was to determine if listeners perceive speakers with aphasia to be less favorable than neurotypical speakers. It also examined the effects of simulated speech fluency on listeners perceptions of individuals with aphasia. **Method:** Six audio samples from people with aphasia and three samples produced by neurotypical adults were obtained from the AphasiaBank database and used in this study. The aphasic audio samples were copied and altered to create a simulated fluent audio sample. Listeners rated the nine samples according to their perceptions about speech, speaker’s attributes, and their feelings regarding the audio samples, and results were analyzed.
Conclusions: Results of this study show that the speech samples by neurotypical adults were rated more favorably than aphasic speech samples. The modified aphasic audio samples were rated more favorable than non-modified audio samples, indicating that fluency in aphasic speech does affect listeners perceptions. Relevance to current study: This study shows is a perceptual study and shows that fluency does affect listeners perceptions for aphasic speech. The current study will examine pause specifically, as an aspect of fluency, and how it affects listeners perceptions of aphasic speech.


Objective: The objective of this study was to examine the effects of hesitations in speech in regard to individuals’ ratings of personality based on speech perception. Method: Two extracted taped speech samples from a prior study were selected. One sample included many hesitant pauses, while one sample had natural speech. Forty judges rated their perceptions of personality trait adjectives based on the speech tapes on a nine-point scale. The traits were classified as highly desirable, neutral, or low desirability. Additionally, judges rated the speakers on three affect-related traits including anxious, tense, and nervous. Conclusions: Overall, judges rated the speaker without hesitant pauses more favorably on trait adjectives than the speaker with hesitations. However, ratings were not different for hesitant and non-hesitant speakers on the three affect traits. Researchers noted, however, that judges were asked to rate speakers on stable personality traits and were also made aware of the nature of the speaker’s task, which may have impacted the judgment of traits. Relevance to current Study: This study considers perceptual impacts
of pause or hesitations of speech. Likewise, the current study examines the perceptual effects of pause in speech specifically for individuals with aphasia.


**Objective:** This study examined the consequences of silent pauses for listeners based on Event-Related Potential (ERP). It looked at how silent pauses affect how listeners process speech and representations of utterances. **Method:** Participants listened to both fluent and disfluent utterances with pauses that ended in either predictable or unpredictable target words. Electrophysiological data was recorded from electroencephalogram (EEG) and electro-oculograms (EOGs) during the task. Additionally, the participants participated in a recognition memory task from the sentences to determine if they could recognize words that had been stated after silent pauses. **Conclusions:** Based on ERP data, the N400 effect, or electrical activity was diminished when a pause preceded unpredictable target words. For the utterances with pause, unpredictable target words correlated with late left frontal lobe positive activity. From the working memory task, listeners were better able to recognize words that had been stated after silent pauses. Overall, the study shows that silent pauses interrupt comprehension for listeners. **Relevance to current study:** This study is relevant to the current study as it examines how listeners process speech with pauses. The current study will examine listeners perceptions of pause.

**Objective:** This study examined the significance of pauses in the perception of sentences. The study consisted of two experiments examining pause in perception of semantic categorization as well as the effect of pause in sentence recall and comprehension.

**Method:** In the first experiment sentences were constructed, some with various pauses at different grammatical locations, and some at nongrammatical locations. Subjects indicated when and if the sentence contained examples of relevant categories and were timed in which the words were detected. In the second experiment, subjects were presented with the sentences with pauses either at grammatical or nongrammatical locations. They were then asked to recall the sentences and scored on speech and accuracy. **Conclusions:** The results of this study show that pauses are significant when they occur between clauses within sentences. In sentences with pauses between clauses, words could be categorized more rapidly in experiment one, and sentence recall was more accurate in experiment two. Therefore, the study found that pauses are significant as they influence how listeners can understand utterances. **Relevance to current study:** This study is relevant to the current study as it examined the perceptual effects of pause. The study shows that pause has an impact on listeners interaction with speech, which will be examined in the current study.


**Objective:** The purpose of this study was to investigate how pause and utterance duration is able to differentiate between neurotypical and cognitively impaired adults. **Method:**
Recording of reading samples were obtained from 187 either cognitively healthy or cognitively impaired adults. Static and dynamic temporal thresholds and pause and utterance duration distribution features were extracted from the recordings and analyzed statistically. A Linear Discriminant Analysis (LDA) was used to differentiate between cognitively healthy and cognitively impaired groups based on the extracted data.

**Conclusions:** The pause mixing proportion and utterance mean measures were statistically significant in their ability to classifying participants based on cognitive ability. The dynamic temporal thresholds had a negative impact on classification performance. Pause and utterance duration distribution parameters, however, may be effective in classifying people based on their cognitive function. **Relevance to current study:** This study is relevant to the current study as it examines pause in individuals who are cognitively impaired. Individuals with aphasia often have concomitant cognitive difficulties as well as pause, which is the target group investigated in the current study.


**Objective:** The aim of this study was to isolate cues that impact the perceived confidence in speech. **Method:** A speaker read two (linguistically confident linguistically doubtful) texts in both a paralinguistically confident and paralinguistically doubtful voice. Speech was recorded and analyzed for acoustic properties and mean duration of pauses. Judges rated the recordings based on confidence, expertise, competence, and personality and speech attributes. **Conclusions:** Confidence was found to be manifest by loudness, short pauses, and rapid speech rate. Higher pitch level also was a cue for confidence in some
conditions. Subjects could correctly identify confidence as well as speech conditions for the confidence voice and associated certain personality attributes with the confident voice. Relevance to current study: This study shows that pause has an impact on perceived confidence. The current study will likewise examine perceptual impact of pause for individuals with aphasia.


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

Objective: The purpose of this study was to investigate pause in conversation and determine how reliable pauses are as boundary markers in speech. The study also investigated how well the distribution of pauses compares in different speech types and how pause can be optimized for understanding speech. Method: Speech samples from a variety of settings (various broadcast interviews) was obtained and segmented to the syllable level. The data was also segmented based on durational features (syllable, word, and pause durations) and distance measures. Phrases were categorized into major and minor phrases. Data was analyzed for correlations. Conclusions: Researchers found that pauses correlated well with phrase and boundary markings. However, the strength of these correlations varies. Additionally, it was found that the duration of pause in speech is correlated with the boundary status. Syllable duration was inversely correlated with distance to phrase end. Relevance to current study: This study showed that pause is important in speech performance and helps mark boundaries in speech. This relates to the current study as the perceptual features of pause in individuals with aphasia will be examined.
APPENDIX B

Informed Consent

Consent to be a Research Subject

Title of the Research Study: Communication Impact of Speech Pause
Principal Investigator: Shawn Nissen, Ph.D.
IRB ID#: IRB2020-479

Introduction
This research study is being conducted by Shawn Nissen, Ph.D., at Brigham Young University to
determine how the characteristics of an individual’s speech impacts their ability to communicate
effectively. You were invited to participate because you are a native English speaker with typical
hearing.

Procedures
If you agree to participate in this research study, the following will occur:

- you will participate in a hearing screening by listening to beeps through headphones while seated in a
  listening booth in the Taylor building on the Brigham Young University campus
- you will listen to a series of sentences and short conversations and rate each sample on how well it
  was spoken using a computer mouse to select a button on the screen
- the entire study will take 55 minutes to complete

Risks/Discomforts
There are minimal risks for participation in this study. You may encounter some discomfort from
wearing the over-the-ear headphones. You will take a short break in the middle of the study to limit
possible discomfort from wearing the headphones. There is also a small risk that your participation in
the study may be known to others by your signing the consent form. The consent forms will be kept in a
locked cabinet within a locked room to decrease this risk.

In Case of Research Related Injury
BYU makes no commitment to provide financial compensation or free medical care should you be
injured as a result of your participation in this research. Nonetheless, in the event of such an injury, after
seeking appropriate medical attention, please contact Shawn Nissen at (801) 422-5056 or
shawn_nissen@byu.edu.

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 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. The
consent forms with the participant signatures is what will be stored in a locked cabinet.
De-identified data from this study may be shared with the research community, with journals in which study results are published, and with databases and data repositories used for research. We will remove or code any personal information that could directly identify you before the study data are shared. Despite these measures, we cannot guarantee anonymity of your personal data.

**Compensation**

You will receive $10 in cash for your participation in this study.

**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 can contact the principal investigator Shawn Nissen 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 contact Human Research Protections Manager by phone at (801) 422-1461; or by email: irb@byu.edu.

**Statement of Consent**

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

Name (Printed): ___________________________ Signature: ___________________________ Date: ________