Effects of Differential Prolongations of Phrases on the Perceptions of Speech Naturalness

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ABSTRACT: The prolongation of speech sounds/sentences is currently used in stuttering therapy to enhance fluency. However, prolonged speech is often reported by both stuttering speakers and listeners to sound unnatural. The present investigation is an extension of a prior study that examined naturalness perceptions of prolonged vowels (at different durations) in carrier phrases. In the present study, entire phrases were prolonged at four duration levels using digital waveform manipulation. Sixty college students listened to the phrases and rated their naturalness. Results indicated that at the 150% prolongation level, speech was perceived as natural by more than 80% of the listeners, similar to findings in the prior study (i.e., vowel prolongation). A further comparison of the two studies, however, revealed that naturalness perceptions of vowel prolongation were maintained at longer durations than were phrase prolongations.

KEY WORDS: stuttering, phrase prolongation, digitized speech, naturalness perceptions

Prolonged speech is a technique whereby a stuttering speaker decreases stuttering through stretching/prolonging words and reducing speech rate (Packman, Onslow, & Menzies, 2000). Goldiamond (1965), one of the founders of prolonged speech, demonstrated that stuttering could be reduced with delayed auditory feedback (DAF); with the use of DAF, speech could be produced fluently, in a slow, prolonged pattern. Goldiamond developed a method in which this speech pattern was first produced under DAF, attenuated, and then faded. The stutterer could eventually use this pattern without the DAF and speak fluently.

At present, prolongation appears to be the most frequently used procedure for the behavioral control of stuttering. The specific features of the particular speech pattern taught include most or all of the following: (a) reduced speech rate, (b) continuous or extended vocalization, (c) prolongation of words or sounds, (d) soft articulatory contacts, (e) gentle onset of speech and/or voice, and (f) breath stream management. It is not clear which of the procedures are critical in the treatment process, or whether the same features are necessary for all participants (Packman & Onslow, 1994).

Most clinicians using behavioral treatment programs train stutterers to use prolonged speech on a continual basis (throughout all utterances), but also to release from a block or from an uncontrolled part word or syllable repetition. Studies have shown correlations between decreased speech rate, increased vowel durations, and increased fluency with both methods (Mallard & Westbrook, 1985; Metz, Samar, & Sacco, 1983; Perkins, Rudas, Johnson, Michael, & Curlee, 1974; Ramig, 1984). The slow rate of speech may sound unnatural, until it is eventually shaped into more natural sounding speech by increasing speech rate (O’Brian, Onslow, Cream, & Packman, 2003).

Treatment, however, often results in the perception of reduced speech naturalness, as judged by both speaker and listener (Franken, Boves, Peters, & Webster, 1992; Ingham, Gow, & Costello, 1985; Ingham & Packman, 1978; Martin, Haroldson, & Triden, 1984). Additionally, stutterers do not always generalize speech prolongation because they feel that it sounds unnatural (Franken et al., 1992; Kalinowski, Noble, Armson, & Stuart, 1994; Martin et al., 1984; Metz, Schiavetti, & Sacco, 1990; Onslow & Costa, 1996; Onslow,
Hayes, Hutchins, & Newman, 1992; Runyan, Bell, & Prosek, 1990). In addition, Ingham, Ingham, Onslow, and Finn (1989) found that independent listeners and stuttering speakers have different criteria and bases for judging speech naturalness. Furthermore, some clinicians appeared to give inconsistent feedback to their clients regarding their prolonged speech productions; this conclusion was based on the relatively low degree of intra- and interclinician agreement in a particular program (Onslow & O’Brien, 1998).

Although attempts have been made to relate acoustic variables to speech naturalness, or to analyze fluency treatment with listeners’ judgments (Ingham et al., 1985; Ingham et al., 1989; Martin et al., 1984; Metz et al., 1990), quantified acoustic variables were not determined. As of 1998, no study had investigated the criteria regarding (a) what is considered normal or (b) the acoustic parameters underlying speech naturalness (Ingham & Riley, 1998). To be of clinical use, it is important for clinicians to have a reference regarding which parameters are considered natural in relation to prolonged speech. As summarized by Schaeffer and Eichorn (2001), behavioral treatment programs may achieve fluent speech, but at the expense of normal speech. That is, prolonged speech may be successful in modifying stuttering, but the quality of speech is diminished in terms of naturalness. Additionally, stutterers may fail to carry over prolonged speech because they think it does not sound natural. With acoustic references, individuals can prolong speech at a particular duration, and with practice, shorten the duration time to where most listeners perceive the utterance as natural.

A study by Schaeffer and Eichorn (2001) addressed this limitation in existing research by relating acoustic parameters of speech to listener judgments of speech naturalness. These authors assessed the perception of naturalness when vowels were prolonged in carrier phrases (e.g., Say cake again; Say p in again) at three different duration levels. The authors selected vowel duration because this acoustic parameter (a) can be correlated with speech naturalness (Metz et al., 1990; Prosek & Runyan, 1982, 1983), (b) can be prolonged as a result of prolonged speech treatment (Mallard & Westbrook, 1985; Metz et al., 1983), and (c) is perceptible to stuttering speakers, as evidenced by clinical experience. The study revealed that prolonged vowels in words of phrases (e.g., Say cake again; Say p in again) at prolonged levels of 150% (1.5s) were regarded as natural to a large percentage of the sample in the study. Eighty-three percent of a sample of 52 college students, who were nonstutterers, perceived prolonged speech to be natural at the 150% prolongation level (PL), and more than 50% of the participants perceived speech to be natural at the 200% PL (2.0s). Speech was generally perceived as unnatural at the 250% PL (2.5s). This study, however, focused only on the prolongation of vowel sounds in words of phrases. Nevertheless, this investigation was a first step in finding parameters regarding naturalness perceptions of prolonged speech. The design of the research, however, was very tightly controlled, making it difficult to generalize to other areas of prolongation (whole words, phrases, sentences).

The present investigation, therefore, was undertaken to extend the previous research to determine at which durations speech naturalness is maintained when an utterance of increased length is prolonged. According to Onslow and Packman (2002), there is support for the hypothesis that rhythmic speech and prolonged speech do not rely on auditory stimulation and help reduce stuttering because fewer demands are placed on the speech motor system. This information suggests that teaching a stutterer to prolong phrases or sentences can allow him or her to control his or her rate by taking the time to plan before articulating. These findings suggest that prolonged speech is, at present, an important behavioral technique to control stuttering. It is therefore imperative that we find parameters to determine at which values prolonged utterances of increasing length can be perceived as natural in order to promote carryover and perceptions of naturalness.

The purpose of the present investigation, therefore, was to prolong the entire phrase/s used in the previous study (e.g., Say cake again) at four durations in random order. The following questions were asked:

- At what durations do listeners perceive prolonged phrases to be unnatural?
- Is there a quantifiable difference in naturalness perceptions of prolonged phrases as compared to phrases in which a vowel within a key word is prolonged?
- Does context influence naturalness perceptions of prolonged phrases, and how do the results compare with context influence of vowel prolongation?

The answers to these questions will give clinicians a reference value to use in therapy when phrases are prolonged in terms of naturalness perceptions, particularly in comparison to vowel prolongation. Additionally, the study will tell clinicians which contexts can initially be used in therapy to obtain naturalness more immediately when prolonging speech.

**METHOD**

**Participants**

Sixty college students, 30 males and 30 females between the ages of 18 and 29 (mean age = 21 years), were selected from the student body of Brooklyn College as listeners. They were recruited from the Brooklyn College campus or referred by their friends or professors. Students were from the New York City area and their primary language was English. Students who grew up in another country were not included in the study because their perception of speech naturalness may have been different from the perceptions of students who grew up in the United States. Moreover, the students were chosen from disciplines other than speech-language pathology (e.g., math, computer science, film, biology); additionally, interviews with them revealed that they had no experience with any speech-language disorder or therapy with regard to themselves, their families, or friends. It was thus indicated that they
had no familiarity with stuttering and were unaware of the purpose of the study. Furthermore, they had never participated in listening studies. As in the previous study, the students were instructed to judge whether they “strongly agreed,” “agreed,” or “disagreed” that the phrases sounded natural. All participants received a speech and hearing screening to determine that both speech and hearing were within normal limits.

Materials and Procedures

An adult female speaker (first author, original study) recorded 12 phrases into a Kay Elemetrics Computerized Speech Lab (CSL) using a Shure condensor microphone (BG 4). The phrases included say cake again, say tote again, say bed again, say pat again, say cup again, say took again, say good again, say pat again, say bead again, say tot again, say Pete again, and say toot again. The speaker produced the phrases in a natural conversational voice, controlling sound pressure levels and timing/duration to preclude large variances. In order to ascertain that large decibel levels did not occur among phrases, and that these levels remained reliable, the researcher spoke each phrase into a digital sound level meter (Tandy Corporation) a number of times to obtain stable values; these values were between 64 and 65 dB (one phrase was 66 dB), with a mean of 64.79 dB. In terms of timing or duration, each phrase was captured into the CSL, and the waveform and timing output (in seconds) were observed on the computer screen. To ensure reliability, the author repeated the phrases several times until the values were observed to be steady.

The duration of these phrases was stabilized between 1.2 s and 1.6 s, with a mean of 1.4 s. When the decibel levels and timing values of the phrases were reliable, the phrases were saved on the CSL (See Table 1 for a delineation of the original phrase production).

The phrases, captured in the CSL (as explained) were prolonged in the Analysis Synthesis Laboratory (ASL). After exiting from the CSL, the data were transferred to the ASL program, as noted. The steps in the ASL program are the following:

1. Enter the waveform of the particular phrase at the top of the computer screen.
2. Access the Lens Column (a column of numbers) to appear below the waveform.
3. Press the arrow key on the computer slowly down the Lens Column, until a cursor moves to the beginning of the waveform above.
4. Press the corresponding number on the Lens Column, which will turn gray.
5. Press the page down key on the computer until the cursor above is at the end of the waveform.
6. Subsequently, all the numbers in that section of the Lens Column turn gray to indicate that the entire waveform (phrase) has been captured.
7. When that process is completed, enter the number by which the waveform is to be lengthened (e.g., 2.0 × original duration) and the data are synthesized; that is, the phrase is lengthened.

Each phrase was prolonged at four percentage levels: 150% (1.5 × the original phrase duration), 170% (1.7 × the original phrase duration), 190% (1.9 × the original phrase duration), and 210% (2.1 × the original phrase duration), proportionately increasing phrase duration. Prolongation levels smaller than 150% sounded similar to the original; thus, 150% was the smallest prolongation level chosen. The order of prolongation levels was randomized to counteract a possible order effect.

Piloting was conducted to determine which duration levels to use for the present study. Ten participants first listened to the phrases prolonged at the same duration levels as the vowels in the previous research, which were 150%, 200%, and 250%. When the entire phrase/s was prolonged at these levels, results were the following: Many participants agreed that phrases prolonged at the 150% PL sounded natural, but very few participants judged phrases prolonged at the 200% level to be natural. All participants, however, perceived phrases prolonged at the 250% PL to be unnatural, and this value was thus excluded. Experimentation revealed that a number of participants perceived phrases prolonged at 170% PL and 190% PL (depending on the context) to be natural. After considering the above results, it was determined that phrases for the present study should be prolonged at even increments of 20% at the following duration levels: 150%, 170%, 190%, and 210%. The increment to 210% PL was included to approximate the 200% PL of the previous study.

The selected vowels in the words of the phrases included front, back, and middle vowels. The initial and final consonants selected were voiceless plosives and were designed to make nine real words (e.g., cake, took, pet, cup). An additional three words began and ended with voiced stop plosives (e.g., bead) to determine if voicing had any effect on the listener’s perception of phrase prolongation. Voiceless stops were chosen to restrain voicing from influencing the vowel and to limit the continuant feature of fricatives, for example, from affecting the vowel. Voiced phonemes and continuants (e.g., fricatives or any other continuant) were, therefore, excluded to reduce the interference of these

<table>
<thead>
<tr>
<th>Phrase</th>
<th>dB level</th>
<th>Original duration/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say Pete again</td>
<td>65.0</td>
<td>1.472</td>
</tr>
<tr>
<td>Say pet again</td>
<td>64.0</td>
<td>1.434</td>
</tr>
<tr>
<td>Say pat again</td>
<td>65.0</td>
<td>1.539</td>
</tr>
<tr>
<td>Say toot again</td>
<td>64.0</td>
<td>1.664</td>
</tr>
<tr>
<td>Say took again</td>
<td>65.0</td>
<td>1.344</td>
</tr>
<tr>
<td>Say tot again</td>
<td>64.0</td>
<td>1.382</td>
</tr>
<tr>
<td>Say toot again</td>
<td>65.5</td>
<td>1.216</td>
</tr>
<tr>
<td>Say cake again</td>
<td>64.0</td>
<td>1.434</td>
</tr>
<tr>
<td>Say cup again</td>
<td>65.0</td>
<td>1.472</td>
</tr>
<tr>
<td>Say bead again</td>
<td>65.0</td>
<td>1.498</td>
</tr>
<tr>
<td>Say bed again</td>
<td>65.0</td>
<td>1.485</td>
</tr>
<tr>
<td>Say good again</td>
<td>66.0</td>
<td>1.267</td>
</tr>
<tr>
<td>Mean</td>
<td>64.79</td>
<td>1.400</td>
</tr>
</tbody>
</table>
features on the prolongation of vowels in the key words of the phrases. Three words with voiced plosives, however, were included to determine the effect of voicing on the vowels.

The originally produced phrases and those prolonged at different durations resulted in 60 phrases. The first five phrases were used to allow the participants to become familiar with the procedure and were not included in the statistics. These five phrases, however, were again presented randomly at a further point and were then included in the statistics. The participants, therefore, listened to a total of 65 phrases. A program, arranged through Visual Basic, was designed to randomize the phrases and allow the participants to choose (on the computer screen) whether or not they agreed that the phrases sounded natural. They could replay the phrase, if necessary, before making their choice.

The recorded phrases were presented to the participants in random order on a computer screen, and the loudness level could be adjusted if necessary. After hearing each phrase, participants responded by clicking the mouse with regard to whether they strongly agreed, agreed, or disagreed that the phrases sounded natural, using “their own internal standards of naturalness.” (Schiavetti & Metz, 1997, pp. 399–400). After responding to one phrase, the participant would click next on the computer screen and then click play to hear the next phrase. The three-point ordinal scale was used to simplify the judgment task, particularly because the investigator wanted the responses to be spontaneous and without deliberate thought.

**Data Analysis**

Data were transported to a Microsoft Excel spreadsheet and calculated by the computer program after each participant completed the task. The program summed the number of participants agreeing, strongly agreeing, or disagreeing (with regard to each phrase at each duration). The ratings of “strongly agree” and “agree” were combined and categorized as natural because the participants perceived these phrases to be natural regardless of the differences in timing.

**RESULTS**

The present research was conducted (a) to demonstrate quantifiable parameters related to perceived naturalness of speech when an entire phrase was prolonged (i.e., the phrases used in the previous investigation); (b) to compare the results obtained to that of the previous investigation, where only the vowel in a key word in the phrase was prolonged; and (c) to determine the influence of context on speech naturalness during speech prolongation. Specifically, statistics for the present study were based on a univariate analysis of variance, and results were as follows: 100% of the participants perceived the original phrases (nonprolonged) as natural; 85% of the participants rated the phrases as natural at the 150% PL; 54% of the participants perceived the phrases to be natural at the 170% PL; 24% perceived the phrases to be natural at the 190% PL; and only 10% of the participants perceived the phrases to be natural at the 210% PL. These results indicated significant differences with regard to the target variables: speed, \( F(4, 60) = 694.636, p < .001 \); context, \( F(11, 60) = 20.388, p < .001 \); interaction of speed and context, \( F(44, 60) = 2.57, p < .001 \) (see Table 2). There were no significant gender effects or gender by speed interactions. One hundred percent of both females and males perceived original phrases (without prolongation) to be natural. Eighty-four percent of the females and 86% of the males judged the phrases to be natural at the 150% PL; at the 190% PL, 21% of the females and 27% of the males indicated that the phrases sounded natural; and only 7% of the females and 13% of the males perceived the phrases to be natural at the 210% PL (see Figure 1).

**Table 2.** Percentage of subjects agreeing/disagreeing that phrases sounded natural at original and extended durations.

<table>
<thead>
<tr>
<th>Phrase</th>
<th>Original</th>
<th>150% PL</th>
<th>170% PL</th>
<th>190% PL</th>
<th>210% PL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>Say cake again</td>
<td>100</td>
<td>0</td>
<td>87</td>
<td>13</td>
<td>57</td>
</tr>
<tr>
<td>Say tote again</td>
<td>100</td>
<td>0</td>
<td>85</td>
<td>15</td>
<td>48</td>
</tr>
<tr>
<td>Say bed again</td>
<td>100</td>
<td>0</td>
<td>70</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Say pet again</td>
<td>100</td>
<td>0</td>
<td>87</td>
<td>13</td>
<td>58</td>
</tr>
<tr>
<td>Say cup again</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>92</td>
</tr>
<tr>
<td>Say took again</td>
<td>100</td>
<td>0</td>
<td>98</td>
<td>2</td>
<td>80</td>
</tr>
<tr>
<td>Say good again</td>
<td>100</td>
<td>0</td>
<td>90</td>
<td>10</td>
<td>57</td>
</tr>
<tr>
<td>Say put again</td>
<td>100</td>
<td>0</td>
<td>75</td>
<td>25</td>
<td>47</td>
</tr>
<tr>
<td>Say bead again</td>
<td>100</td>
<td>0</td>
<td>88</td>
<td>12</td>
<td>33</td>
</tr>
<tr>
<td>Say tot again</td>
<td>100</td>
<td>0</td>
<td>68</td>
<td>32</td>
<td>35</td>
</tr>
<tr>
<td>Say Pete again</td>
<td>100</td>
<td>0</td>
<td>90</td>
<td>10</td>
<td>65</td>
</tr>
<tr>
<td>Say toot again</td>
<td>100</td>
<td>0</td>
<td>83</td>
<td>17</td>
<td>48</td>
</tr>
</tbody>
</table>

Means of agreement 100 85 54 24 10

*Note.* PL = prolongation level.
The present investigation’s findings, compared to that of the previous study, revealed that naturalness perceptions break down at longer durations when the entire phrase is prolonged in comparison to when only the vowel in a key word is prolonged. Both studies, however, indicated that at the 150% PL, speech is considered natural by more than 80% of the listeners. Certain contexts in the present study (i.e., phrases containing the words cake, cup, pete, pet, and took) were still considered natural at the 170% PL by more than 50% of the participants.

DISCUSSION

General findings that emerged from the present study included the following:

- The duration of phrase prolongation influences listeners’ perception of naturalness.
- At certain duration levels, there is a difference in naturalness perceptions when entire phrases are prolonged in comparison to prolonging only the vowel within a word in the phrase.
- Certain contexts in prolonged phrases retain their naturalness longer than others, which points to the influence of context on the perception of naturalness.

Past research has shown that as a therapy technique to control stuttering, prolonged speech frequently results in speech that is perceived as unnatural (Ingham et al., 1985; Ingham & Packman, 1978; Martin et al., 1984). The present research was conducted (a) to demonstrate quantifiable acoustic parameters related to perceived naturalness of speech when an entire phrase was prolonged (i.e., the phrases used in the previous investigation); (b) to compare the results obtained to that of the previous investigation, where only the vowel in a key word in the phrase was prolonged; and (c) to determine the influence of context on speech naturalness during speech prolongation.

The present investigation revealed that naturalness perceptions break down at longer durations when the entire phrase is prolonged in comparison to when only the vowel in a key word is prolonged. This finding is not surprising. Vowel prolongation may become embedded in the utterance and not be noticed at longer durations, as the phrase would. It is interesting to find, however, that more than 80% of the participants in both studies perceived both prolonged phrases and vowels to be natural at the 150% level. These data suggest that listeners may perceive this level of prolongation to be slower speech, but not necessarily unnatural.

Table 3 and Figure 2 delineate the specific comparisons between vowel and phrase prolongation at different durations: More than 80% of the participants in both studies agreed that the phrases sounded natural at the 150% PL; that is, 85% of the participants in the present study and 83% in the prior study. Other results, however, differed from that of the previous study for certain duration levels. In the present investigation, only 10% of the participants perceived the prolonged phrases to be natural at the 210% PL, but more than 50% (52%) of the participants perceived the prolonged vowels to be natural at the 200% PL in the original investigation. In the present study, only 24% of the participants perceived prolonged phrases to be natural at the 190% PL, whereas 52% of the participants (as noted) perceived the phrases to be natural at the longer duration of 200% PL in the previous study. Furthermore, the low 24% perceived naturalness at the 190% PL approximated the low 22% of perceived naturalness at the longer 250% PL in the original study. With regard to the 170% PL in the present...
Table 3. Percentage of male and female participants and total participants perceiving vowels and phrases as natural at original and extended durations.

<table>
<thead>
<tr>
<th></th>
<th>Prolonged vowels</th>
<th></th>
<th>Prolonged phrases</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Females</td>
<td>Males</td>
<td>Total</td>
<td>Females</td>
</tr>
<tr>
<td>Original</td>
<td>100%</td>
<td>98%</td>
<td>99%</td>
<td>Original</td>
</tr>
<tr>
<td>150% PL</td>
<td>83%</td>
<td>84%</td>
<td>83%</td>
<td>150% PL</td>
</tr>
<tr>
<td>200% PL</td>
<td>53%</td>
<td>52%</td>
<td>52%</td>
<td>170% PL</td>
</tr>
<tr>
<td>250% PL</td>
<td>22%</td>
<td>21%</td>
<td>22%</td>
<td>190% PL</td>
</tr>
<tr>
<td>210% PL</td>
<td>7%</td>
<td>13%</td>
<td>10%</td>
<td></td>
</tr>
</tbody>
</table>

study, 54% of the participants rated the phrases as natural—a finding similar to vowel prolongation ratings at the 200% PL in the first study. The impact of prolonged phrases may not be as strong at the 170% PL because this level is closest to the 150% PL, where a high naturalness perception was found. Furthermore, certain contexts retained their naturalness ratings at the 170% PL (i.e., words *cake*, *cup*, *took*, *pet* and *Pete*). Phrases that did not contain these words at the 170% PL had a rating of less than 50% in terms of perceived naturalness. This finding suggests the influence of context on the speech perception of naturalness.

Moreover, the words *cake*, *cup*, *took*, and *Pete* also maintained their naturalness perceptions at longer durations (200% PL) in the previous study. The velar sounds (e.g., *cup*) may have a slower release, reducing the prolongation effects on the vowels, and the tense vowel in *Pete* may have naturally sounded longer. According to Hillenbrand, Getty, Clark, and Wheeler (1995), tense vowels are longer than lax vowels. It is not clear why the word *pet*, with a lax vowel, maintained its naturalness in the present study and not in the original research. Words with voiced consonants (i.e., *bead* and *good*) also maintained naturalness at longer durations in the previous study. This finding did not occur in the present study. Because voiced consonants normally increase vowel durations (Allen & Miller, 1999; Port & Rotunno, 1979), differences between the original and prolonged vowels may have been less prominent to listeners in the first study. In the present study, however, the prevocalic voiced consonant may have resulted

Figure 2. Percentage of total participants perceiving vowels and phrases to be natural at original (0 = original) and extended durations.
in the entire phrase sounding longer as its duration increased. Empirical support for these findings regarding context is weak and further research is necessary.

According to Perkins, Kent, and Curlee (1991), a dyschrony (which results in stuttering) may occur when the abnormal pressure of time demands a continuation of the utterance. Therefore, teaching a client to prolong phrases or sentences can allow him or her to control his or her rate (taking time to plan before articulating). Prolonged speech may have some of the features of singing or intoning in terms of using the right brain. For example, melodic intonation therapy (intoning speech) is thought to incorporate the right brain, facilitating the speech of individuals with apraxia (Helm-Estabrooks, Nicholas, & Morgan, 2000, pp. 302–303). According to Onslow and Packman (2002), there is support for the hypothesis that rhythmic speech and prolonged speech do not rely on auditory stimulation and help reduce stuttering because fewer demands are placed on the speech motor system.

The above data have implications for therapy in accordance with the findings of the author’s previous and present studies on speech naturalness. For those individuals who need to prolong entire phrases or sentences to be fluent, prolonging at the 150% PL can allow them the benefits of prolonged speech with the perception of naturalness. They can always begin at a longer duration and gradually reduce the duration to 150% PL where speech is generally considered natural, according to the listeners in this study. Listeners realize that people speak at different speech rates, and a stutterer who prolongs at the 150% level may simply be perceived as a person who speaks slowly, not necessarily unnaturally. Individuals who can prolong at the moment of stuttering to pull out of a block may prolong the particular sound or vowel somewhat longer than the 150% PL and still be perceived as natural by some (in comparison to prolonging the entire phrase). These individuals may also reduce the duration level to 150%. Both methods may be used when appropriate. Incorporating visual feedback of prolongation levels (e.g., Visipitch), with an explanation of duration levels and naturalness perceptions, could motivate the stutterer to practice reducing prolongation levels and remain fluent. If the client realizes that others perceive his or her speech as natural at a particular prolongation level, he or she may be more willing to use the prolonged speech for carryover. Additionally, the present study (as in the previous research) suggests that certain contexts may influence the perception of phrase naturalness during prolongation. Using these contexts during initial therapy may facilitate fluency and speech naturalness.

LIMITATIONS

This study has certain limitations because the variables need to be controlled to obtain acoustic parameters. Although the investigation was extended to prolonging phrases, the same carrier phrase was used for all phrases. More varied phrases and sentence lengths should reveal additional data. Moreover, the results of this study are applicable only to the participants in this investigation. Further research should test groups of different ages and diversities.

CONCLUSION

The purpose of this study was to extend the previous research on speech naturalness perception by demonstrating quantifiable acoustic parameters related to perceived speech naturalness when entire phrases were prolonged. A comparison of the data in the present study to that of the original study revealed that speech naturalness is maintained at longer durations when only the vowel in a key word in a phrase is prolonged. The present investigation revealed that naturalness perceptions break down at longer durations when the entire phrase is prolonged. Both studies, however, indicated that at the 150% PL, speech is considered natural by more than 80% of the listeners, a finding that may contribute to carryover of prolonged speech to control stuttering. Although the data are weak, certain contexts appear to influence speech naturalness perceptions.

FUTURE RESEARCH POSSIBILITIES

Future research possibilities include the use of prolonged phrases in various contexts (e.g., fricatives, nasals, liquids) to determine their influence on naturalness perceptions. Certain contexts may facilitate speech naturalness more readily than other contexts and can be used in the initial stages of prolongation therapy. Another area for research would be to determine how naturalness is maintained during the prolongation of sentences of varying lengths. Further research can also test and compare the perceptions of different age groups and diversities. Perceptions of various diversities can be compared to English-speaking participants as well as to each other. Results from such studies may help clarify in which populations the perceptions of naturalness of prolonged speech (at various prolongation levels) occur. Such information may extend our understanding of the perception of speech naturalness in prolonged speech.

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