Research Note

Eliciting Stuttering in Laboratory Contexts

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Purpose: The contextual variability of stuttering events makes it difficult to reliably elicit stuttered speech in laboratory settings. As a result, studies that compare stuttered versus fluent speech are difficult to conduct and, thus, are limited in the literature. The purpose of the current study is to describe a novel approach to elicit stuttering during laboratory testing.

Method: A semistructured clinical interview leveraging the phenomenon of stuttering anticipation was administered to 22 adults who stutter (1st visit). The interview was used to generate participant-specific anticipated and unanticipated word lists, which were used as stimuli

during a 2nd visit so that the validity of the method could be tested.

Results: The method yielded a near-equal distribution of unambiguously stuttered and fluent utterances (43.6% and 43.5%, respectively). Moreover, 12.9% of the utterances were judged to be ambiguous, that is, not unambiguously stuttered or fluent.

Conclusion: This approach outperformed previous attempts to elicit stuttering during laboratory testing. It could be implemented in future studies that compare neural, physiological, or behavioral correlates of fluent versus stuttered speech.

Reliably eliciting stuttered speech during laboratory tasks is a significant methodological challenge in stuttering research. This is because stuttering events are context based and intermittent and, as a result, generally not predictable. It is common for many people who stutter (PWS) to experience very little or even no stuttering during laboratory tasks. This is problematic, particularly for researchers assessing neural and physiological correlates of stuttering because, in the absence of overt stuttering, it is difficult to determine whether the neural, autonomic, or other activity measured is associated with stuttering at all.

There are a number of constraints to the reliable elicitation of stuttered speech for research purposes. Most laboratory speech tasks involve PWS responding to prompts on a monitor rather than to another individual, which reduces the communicative pressure associated with speech and, in turn, reduces the probability of stuttering. For example, increased propositionality (Eisensohn & Horowitz,

1945) and speaker concern about the listener or desire for social approval (Ramig, Krieger, & Adams, 1982; Sheehan, Hadley, & Gould, 1967; Yovetich & Dolgoy, 2001) both increase stuttering. In addition, in order to control for linguistic or motor complexity, stimuli are often less grammatically complex or shorter compared to spontaneous speech, which also reduces the probability of stuttering (e.g., Kleinow & Smith, 2000; Sawyer, Chon, & Ambrose, 2008; Yaruss, 1999). Furthermore, novel modes of speaking and distraction (e.g., loud noises) are both known to reduce stuttering (Bloodstein & Bernstein-Ratner, 2008). Functional magnetic resonance imaging, for instance, requires participants to lie in a supine position (i.e., on their backs) while loud noises are emitted from the machine, which may induce both a novel mode of speaking and distraction. Because of the low stuttered/fluent ratio that results from these conditions, it is difficult to make meaningful comparisons of the neural, physiological, or behavioral correlates of stuttered and fluent speech.

Previous studies that employed methods to elicit stuttered (and fluent) speech, mostly neuroimaging studies, reported low levels of stuttering—mean stuttering rates ranged from 2.5% to 14% (Ingham, Grafton, Bothe, & Ingham, 2012; Toyomura, Fujii, Yokosawa, & Kuriki, 2018; Toyomura, Yuasa, & Kuriki, 2011). Interestingly, although the primary goal of Toyomura et al. (2018) was not to examine stuttered speech, steps were taken to increase the probability of stuttering during that study (e.g., matching participants with a member of the opposite sex, which they argued increased communicative stress). Two early

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studies (Fox et al., 2000; Ingham et al., 2004) achieved higher rates of stuttering using a method that involved marking stuttering if it occurred during a 4-s interval. Approximately 60%–70% of the intervals during a reading task were marked as stuttered. However, because these intervals contained both stuttered and fluent speech, the approach is not ideal to disentangle the correlates of stuttered versus fluent speech.

One promising approach for increasing the probability of stuttering for research purposes is to leverage the phenomenon of stuttering anticipation. Anticipation refers to the speaker's cognitive sense that upcoming speech will be stuttered should that speech be executed as planned (Jackson, Yaruss, Quesal, Terranova, & Whalen, 2015). Early studies on anticipation primarily tested whether anticipation causes stuttering, which evidence does not support (e.g., Johnson & Sinn, 1937; Johnson & Solomon, 1937). More recent studies have focused on the impact that anticipation has on speech production (Arenas & Zebrowski, 2017) and the extent of anticipation in adults and children and responses to anticipation (Jackson, Gerlach, Rodgers, & Zebrowski, 2018; Jackson et al., 2015). In addition, two theoretical accounts of anticipation have been proposed (Arenas, 2017; Garcia-Barrera & Davidow, 2015). In the current study, we leverage anticipation and its foundation in learning and memory (i.e., past history of stuttering allows participants to indicate which words/sounds they are more likely to stutter) as well as findings that suggest that all adults who stutter (AWS) experience anticipation in the absence of cognitive impairment at least some of the time (Jackson et al., 2015) to develop a method to elicit stuttered speech.

Several researchers have leveraged anticipation to study stuttering events. In a case study, den Ouden, Montgomery, and Adams (2013) relied on a single participant's ability to identify specific sounds/words that he was likely or unlikely to stutter on, which were used to create a list of 24 anticipated/unanticipated words. In that study, 52 trials were stuttered and 44 were produced fluently by the participant. Similarly, Wymbs, Ingham, Ingham, Paolini, and Grafton (2013) determined anticipated/unanticipated words for their participants ($n = 4$) during a pretesting procedure in which the participants read a list from a corpus of words, and based on their productions, the likelihood of stuttering during testing was determined by either the experimenter or the participant. This resulted in each participant having a list of between 30 and 44 words, from which 12 overtly stuttered and 12 fluent utterances were extracted for analysis. The distribution of stuttered versus fluent productions was not reported by Wymbs et al., and it appears that participants produced words until 12 utterances were overtly stuttered, which likely was time consuming. In addition, it appears that the four participants were selected based on their ability to identify anticipated and unanticipated words. Some AWS may be less skilled at identifying anticipated words, especially without an understanding of the concept of anticipation.

In the largest controlled study ($n = 13$) to leverage anticipation to elicit stuttering, Bowers, Saltuklaroglu, and

Kalinowski (2012) examined the relationship between autonomic arousal via skin conductance and anticipatory anxiety and stuttering. They asked their participants to use a 9-point scale to rate the likelihood that they would stutter if producing particular sounds (1 = *not likely to be stuttered*, 9 = *very likely to be stuttered*).¹ The ratings were used to create 20 three- to five-word phrases in which the initial sound of the first word was either anticipated (10) or neutral (10). Of all anticipated phrases, 51% were stuttered and 49% were not stuttered. Overall, only 17% of the participants' productions were stuttered, whereas 83% were produced fluently (Bowers et al., 2012).

The above studies highlight the benefits and challenges of leveraging anticipation to elicit stuttering during laboratory testing. The amount of stuttering elicited in these studies, however, and the small number of participants in most of them are not adequate for making statistically valid comparisons between neural and physiological activity associated with stuttered and fluent speech. In addition, it is possible that a larger sample will mitigate the potential problem of selecting only participants who are able to reliably identify words that are more and less likely to be stuttered, which would reduce sample bias. Methods for eliciting stuttering can be enhanced by incorporating counseling skills during a clinical interviewing process. In this article, we present a method for interviewing research participants to develop anticipated/unanticipated word lists to be used during future studies that compare correlates of stuttered and fluent speech. Applying this approach also provides comfort to participants who may experience cognitive or emotional reactions to identifying/producing anticipated words, which we argue is a more ethical approach to conducting experiments with AWS. Finally, we present behavioral results to validate our approach.

Method

This study was approved by the Institutional Review Board at New York University, and informed consent was obtained from all participants. There were two visits per participant. The first visit included diagnostic procedures (see Participants section) and the clinical interview (see Clinical Interview section). During the second visit, participants produced stimulus words generated from the clinical interview during a separate functional near-infrared spectroscopy (fNIRS) study. The stimulus word lists were generated based on the interview (see Clinical Interview section). Details relevant to the elicitation of stuttered and fluent speech in AWS will be presented in this article. The fNIRS

¹Anticipated words are often referred to as *fear*ed words by speech-language pathologists, researchers, and PWS themselves, which implies an emotional source of anticipation. We do not take this view—rather, we believe that the source of anticipation is cognitive and learned. Emotional reactions (e.g., fear, anxiety) often co-occur with anticipation (for further discussions, see Jackson et al., 2018, 2015).

results comprise a separate study and will be presented elsewhere.

Participants

Participants included 22 AWS (10 women) with a mean age of 31.9 years and an *SD* of 9.1. Participants were diagnosed as AWS by the first author, a licensed speech-language pathologist (SLP) with 10 years of experience and expertise in stuttering intervention. All of the participants (a) self-reported as AWS and (b) exhibited at least three stuttering-like disfluencies with associated accessory behaviors (e.g., eye blinking, loss of eye contact, head movements) during a 5-min spontaneous conversation. All participants reported English to be their primary language currently and reported a negative history of neurological, hearing, language-learning, or speech-language impairment (other than stuttering).

Clinical Interview

The (mostly) semistructured interview relied on basic clinical interviewing techniques and clinical expertise about anticipation and how it impacts AWS. The primary goal of the interview was to generate a list of 10 anticipated and 10 unanticipated words for each participant (i.e., words that were expected and not expected to be stuttered). We targeted the identification of 10 anticipated words, specifically, based on clinical experience/expertise in conjunction with the time allotted for the interview. The interview was conducted in an empathetic manner because eliciting anticipation/stuttering can be stressful for many AWS (Jackson et al., 2015). The interview was conducted no more than 10 days prior to the experiment during which the method was tested in an fNIRS study. All clinical interviews were conducted by the first author. Two interviews took place via Skype due to logistical issues.

Build Rapport via Unstructured Conversation

The first part of the interview consisted of unstructured conversation during which the interviewer demonstrated enthusiasm (e.g., “It’s really great that you were able to come in today...thanks for helping us with our work!”), interest (e.g., “...your job sounds interesting....”), consistent eye contact, and attentiveness, among other basic counseling skills (e.g., Luterman, 2017). This was meant to establish researcher–participant rapport as doing so has been shown to have positive effects on patient satisfaction, treatment compliance, and client outcome (Leach, 2005). It was critical that the clinical interview be carried out in a manner that facilitated the participants’ trust that their experiences with stuttering were heard and accepted (Ginsberg & Wexler, 2000). Revealing personally relevant words with a history of association with stuttering may elicit negative emotions (e.g., shame, embarrassment, guilt) and can be difficult for many PWS. Plexico, Manning, and DiLollo (2010) found that effective therapeutic alliances are supported by the therapist’s understanding of the

stuttering experience. Therefore, it was essential that the interviewer demonstrated a deep understanding of the stuttering experience, thus allowing the participant to express themselves honestly without fear of judgment. For example, it was the first author’s perception that saying, “Some people who stutter have told me that they know which words are going to be difficult for them—that sounds like it could be really frustrating,” had the effect of increasing willingness by the participants to share their experiences with anticipation. Furthermore, in our clinical experience, participants are more willing and/or able to identify anticipated words if trust is established between the researcher and the client/participant. These initial conversations lasted approximately 5 min.

Confirm Anticipation

The researcher then asked the participants, “Do you know what stuttering anticipation is?” All participants were able to at least provide a basic definition of anticipation (e.g., “...when you know you’re going to stutter before you actually do”). Minimal prompts were necessary in some cases (e.g., “Do you ever know that you’re going to stutter before you actually do?”). The participants were then asked to provide examples of when they anticipated stuttering, which we found was helpful in facilitating a deeper discussion about anticipation and the participant’s experience with it. In the unlikely case that a participant reported not experiencing anticipation, he/she would have been excluded from the study (though this was not the case with any participants).

Identify Anticipated Words

The researcher then asked the participants whether there are words that he/she has particular difficulty with or knows that he/she will stutter on (i.e., anticipated words). This was accompanied by the researcher stating, “...for example, many people who stutter say that saying their names is difficult...is this true for you?” In most cases, the participants provided at least a few anticipated words after this prompt. To further probe anticipated words, the researcher asked about words that are commonly difficult for PWS. For example, many adults report experiencing difficulty with words that have personal relevance and words they consider as “cannot be changed” (e.g., hometown, occupation, partner’s name). In addition, the researcher asked the participants about particular sounds that were difficult and used these sounds to ask about specific words that began with these sounds. For most participants, these steps were sufficient to generate a list of 10 anticipated words. For participants who did not identify 10 anticipated words, the researcher then asked about words/sounds that he observed during the interaction to be difficult for the participant (whether overtly stuttered or accompanied by subtle atypical hesitations/circumlocutions). For example, if the participant stuttered on a word that began with /p/, the examiner would both ask about that particular sound and ask questions that required the participant to produce

words that begin with /p/ (e.g., “What do you write with?”). This final step facilitated the identification of 10 anticipated words for all 22 participants.

Identify Unanticipated Words

Before beginning this part of the interview, the researcher noted the number of syllables for each of the 10 anticipated words so that the unanticipated words could be matched for syllable length. This step was meant to control for potential confounding effects of grammatical complexity or length, which are known to differentially impact PWS (Kleinow & Smith, 2006; Meltzer, McArdle, Schafer, & Braun, 2009; Schuster, Hawelka, Hutzler, Kronbichler, & Richlan, 2016). The researcher then inquired about unanticipated words (i.e., “Are there words, or sounds that begin words, that are particularly easy for you or don’t give you trouble?”). Most participants were able to identify at least a few words as unanticipated. The examiner then asked about particular sounds and then particular words that began with those sounds, as for the anticipated word list. The researcher specifically asked about words such that the words in the unanticipated list had the same number of syllables, overall, as the anticipated word list. For example, for one participant, the anticipated and unanticipated word lists each may have had three two-syllable words, four three-syllable words, and three four-syllable words. This procedure yielded 10 unanticipated words for all 22 participants. Table 1 includes the procedure to identify 10 anticipated and 10 unanticipated words.

Stimuli/Paradigm

The words from the individual anticipated/unanticipated lists served as stimuli. Each word was produced four times for a total of 80 utterances (4×10 anticipated, $4 \times$

10 unanticipated) during an fNIRS experiment in which they were seated in front of a computer monitor while wearing a cap with 80 optodes. The participants responded to questions or sentence completions (e.g., “What is your name?”, “You fly in one of these”) for which the correct responses were the words from the individual lists. For future comparison studies between AWS and controls, each AWS could be matched with a control speaker who produces the same word list such that each anticipated/unanticipated word list is produced by one AWS and one control. The questions/sentence completions were presented auditorally in a delayed-response paradigm; there was a 5-s waiting period between the end of the question and the “go” signal to produce the word (i.e., the monitor in front of the participant turned green). There were eight blocks, each comprised of 10 words, for a total of 80 trials. Data collection lasted approximately 33 min.

Rating System

A 0, 1, and 2 coding system was used by the examiner to indicate whether a word was unambiguously fluent (0), ambiguous (1) or unambiguously stuttered (2). This novel rating system was implemented to account for potential subtle forms of stuttering (e.g., slight hesitations, accessory behaviors). Unambiguous fluency (0) indicated speech without any perceptually apparent disfluency, hesitation, or associated behaviors. Ambiguous (1) indicated speech accompanied by subtle accessory behaviors (e.g., delayed response, eye blinking, articulatory posturing) but free from productions that would ordinarily be categorized as stuttering-like disfluencies. Unambiguous stuttering (2) indicated speech that included stuttering-like disfluencies (i.e., part-word repetitions, prolongations, or blocks). Errors were comprised of nonproductions or incorrect

Table 1. Summary of clinical interview procedure with example prompts.

Phase	Example prompts	Approx. time
Establish rapport/trust (unstructured)	e.g., “How is your day going?” “Did you find the place okay?” “Thank you so much for participating....” “How’d you hear about the study?” All prompts delivered while demonstrating good counseling skills (e.g., good eye contact, attentiveness, validation, enthusiasm)	5 min
Confirm anticipation (semistructured)	e.g., “Do you know what stuttering anticipation is...can you describe what you think it is?” “...anticipation is when you know you’re gonna stutter before you do out loud....”	3 min
Identify anticipated words/sounds (semistructured)	e.g., “Are there particular words that you know you will stutter on?” “Many people who stutter say that saying their name is difficult... is this true for you?” “Some people have difficulty saying where they’re from...does this ever happen to you?” “Are there particular sounds that are difficult for you?” “How about the word XXX...is that a tough one?”	10 min
Identify unanticipated words/sounds (semistructured)	e.g., “Now we’re gonna move to words that you know are easy for you or that you don’t have trouble with...do any come to mind?” “What about particular sounds that you know are easy?” “What about XXX...is that typically an easy word for you?”	7 min

Note. Approx. = Approximate.

productions due to forgetting the answer or producing erroneous speech.

Results

Table 2 summarizes the behavioral results, whereas Table 3 separates the behavioral outcomes by conditions. Sixty trials were removed due to technical issues (1,760–60 = 1,700 total utterances). A paired *t* test revealed that anticipated words yielded more unambiguous stuttering than unanticipated words (458 vs. 284, respectively; *t* = 4.67, *p* < .001), as expected. Interrater reliability for speech classification between the first author and a certified SLP with 8 years of experience and a doctoral student in communicative sciences and disorders, using 510 or 30% of the trials, was found using Cohen's weighted kappa (.85, *p* < .05), indicating high agreement.

Discussion

This article offers a general approach for eliciting stuttered speech during laboratory testing. We extend previous approaches that leveraged stuttering anticipation by proposing guidelines for conducting a clinical interview that probes stuttering anticipation. Our method was validated, yielding a near-equal distribution of unambiguously stuttered and fluent utterances (43.6% vs. 43.5% of the sample, respectively). The only other comparable study because of its

relatively large sample size (*n* = 13) was Bowers et al. (2012) in which only 13% of all of the utterances were stuttered. Thus, our method significantly outperformed previous attempts to elicit stuttered/fluent speech in the laboratory.

Stuttering is known to be a variable condition—its behavioral consequences (i.e., stuttered events) occur intermittently, which is arguably the most challenging aspect of the disorder for researchers, clinicians, and most importantly, PWS. Scientists should be concerned with determining what happens at all levels of the system (e.g., neurological, physiological, behavioral) prior to and during stuttering events in order to build a comprehensive and truly multifactorial understanding of stuttering. This will require a near-equal quantity of unambiguously stuttered and fluent utterances. We believe that researchers themselves can conduct these interviews following a few simple guidelines as presented in this article and in the referenced material. Some researchers may benefit from consultation with an SLP who has expertise in both stuttering and relevant counseling strategies such as active listening and motivational interviewing (e.g., Luterman, 2017; Miller & Rollnick, 2012).

Despite the approximately equal number of stuttered and fluent trials, it was notable that 54% and 36% of the anticipated words were unambiguously stuttered and not stuttered, respectively. This may have been due to the time lapse between the participants' identification of anticipated words and the actual experiment, which was between 3 and 10 days. Some words may not have elicited anticipation

Table 2. Individual behavioral results including participant characteristics, number of trials included for each participant, and utterance classification. Percentage of stuttered utterances is included for each participant.

Participant	Age	Sex	Trials	Unambiguously fluent (0)	Ambiguous (1)	Unambiguously stuttered (2)	% of unambiguously stuttered utterances	Errors
S01	29	F	80	39	7	34	42.5	1
S02	35	F	80	42	9	29	36.3	4
S03	23	M	80	74	6	0	0	4
S04	34	M	80	78	2	0	0	3
S05	26	F	60	3	5	52	86.7	1
S06	48	F	70	8	6	56	80.0	3
S07	21	M	70	39	12	19	27.1	1
S08	23	M	80	29	33	18	22.5	1
S09	29	M	80	38	6	36	45.0	0
S10	34	M	80	2	0	78	97.5	2
S11	37	F	80	50	12	18	22.5	0
S12	39	F	80	7	12	61	76.3	1
S13	23	F	80	5	1	74	92.5	0
S14	47	F	80	48	8	24	30.0	1
S15	42	M	80	58	10	12	15.0	9
S16	18	M	80	10	14	56	70.0	0
S17	30	M	80	19	20	41	51.3	0
S18	29	M	80	31	29	20	25.0	1
S19	39	F	80	34	2	44	55.0	4
S20	25	M	80	58	5	17	21.3	0
S21	22	M	80	33	3	44	55.0	5
S22	50	F	60	34	17	9	15.0	2
Total				739	219	742		43
Total				43.5%	12.9%	43.6%		2.5

Note. F = female; M = male.

Table 3. Group behavioral results separated by condition.

Group ratings for anticipated and unanticipated words	Utterances	% of total	% of condition
Anticipated, stuttered	458	27	54
Anticipated, ambiguous	90	5	11
Anticipated, fluent	302	18	36
Unanticipated, fluent	437	26	51
Unanticipated, ambiguous	129	8	15
Unanticipated, stuttered	284	17	33
Total	1700		

Note. Percentage of total indicates from the entire sample; percentage of condition indicates from within the condition (anticipated vs. unanticipated).

during testing—the momentary nature of anticipation makes it difficult to accurately predict when stuttering will actually occur. For some words, anticipation may be so ingrained such that the probability of stuttering is increased, but for other words, for which anticipation is not so ingrained, the probability of stuttering is reduced. This is especially the case when anticipated words are identified and subsequently produced in different settings. For example, in the current study, anticipated words were identified by participants in a clinical setting during the first visit and then produced in an experimental setting during the second visit. In addition, although fNIRS offers a more natural speaking environment compared to other imaging technologies (e.g., functional magnetic resonance imaging, positron emission tomography), it is less natural than that in typical verbal interactions, during which some AWS may be more (or less) susceptible to anticipation. One way to address this issue would have been to ask participants to identify via button press whether they anticipated the stimulus words. However, we chose not to include this step for two reasons. First, it would have increased the length of the experiment, which likely would have led to increased participant discomfort. Second, the very act of pressing a button and acknowledging anticipation may have impacted the speech production process for some speakers, for example, by delaying speech initiation and potentially mitigating stuttering (see Jackson et al., 2015). An alternative approach would have been to ask participants to rate their level of anticipation just prior to the experiment.

Bowers et al. (2012) found that “feared” and “neutral” sounds elicited a near-equal amount of overt stuttering. Although our distribution was more favorable—54% and 36% of anticipated words were stuttered and not stuttered, respectively, with the remaining 10% being marked ambiguous—the challenge in using anticipation to elicit stuttering is evident. Bowers et al. highlighted the distinction between overt stuttering and the learned association between words/sounds and previous stuttering events, suggesting that the lack of stuttering associated with many feared words and the presence of stuttering associated with many neutral words may have been due to altering speech production prior to its overt realization (e.g., speaking strategies) or because their

stimulus set was unbalanced in terms of fear (i.e., feared vs. neutral rather than feared vs. nonfeared). Here, we implemented the latter approach (i.e., anticipated vs. unanticipated) and achieved a better outcome. Ultimately, we achieved our goal of eliciting an approximately equal number of unambiguously stuttered and overtly fluent productions for a relatively large sample of AWS. The explanation as to how we achieved our goal, particularly the role that anticipation played, should be the subject of future study.

Although not the primary purpose of this work, present findings yield important clinical implications. For example, as described by Van Riper (1973), one’s ability to temporally link cognitive and affective perception to the physical awareness of stuttering moments is an essential precursor to stuttering modification. Furthermore, doing so is foundational to decreasing emotional awareness and increasing behavioral awareness of stuttering—which is at the heart of Williams’s (1957, 1979) “normal talking” or forward-moving speech approach to stuttering treatment. Leveraging anticipation to proactively identify and modify instances of stuttering offers a powerful tool for altering respiratory, phonatory, and/or articulatory parameters to move through the moment of stuttering with reduced tension or greater ease. The ability to elicit “real” stuttering during therapy is challenging for a number of reasons, most notably the relatively low-stress environment the context creates. The findings of this study offer a window into how clinicians can elicit stuttering in therapy with increased reliability, thus providing greater opportunity for PWS to implement techniques within the session—and potentially leading to faster and more durable generalization of therapy techniques (i.e., into real life).

Considerations

One important consideration for investigators who use the approach presented in this article or any approach that elicits stuttered speech is that anticipation is often associated with cognitive and emotional responses such as increased attention (e.g., when substituting words or circumlocuting) or anxiety (e.g., concern about listener judgment). This may particularly be the case for investigators assessing neural activity associated with stuttered speech because special attention needs to be paid to disentangling activation related to stuttered speech specifically and the cognitive or emotional response(s) that may accompany it. Therefore, researchers who conduct this type of work should carefully and rigorously select measures that most appropriately test their hypotheses and design their studies to control for these potential associated cognitive or emotional responses to stuttering. Furthermore, a limitation of the current design is that the anticipated and unanticipated word lists were matched only for syllable number. Feasibly, there are other linguistic variables (e.g., prosody, frequency effects) that could contribute to differential processing in speakers who stutter. Future work could develop an approach for matching to account for more of these linguistic variables.

Future Directions

Future work can use the approach presented in this article to examine the link between anticipation and overt stuttering events, as well as determine better ways to leverage anticipation to elicit stuttering in the laboratory. For example, the interview could be implemented immediately prior to the experiment so that anticipated/unanticipated words are identified in the same context and closer in time to actual production to increase reliability of the participants' judgments of anticipation. In addition, future work should test the feasibility of this approach with children who stutter. Our previous research (Jackson et al., 2018) showed that children who stutter between the ages of 9 and 17 years are able to describe their experience of stuttering anticipation and also identify personally relevant anticipated and unanticipated words given prompts (similar to those provided above). For example, responding to the question, "Do you sometimes know that you're going to stutter before you do?", one 9-year-old replied, "Yeah... like when I'm reading I kinda look ahead to the words and know that I'm gonna stutter on them..." (Jackson et al., 2018). Testing the applicability of this approach with younger speakers will address critical questions about the onset of stuttering.

Conclusion

In this article, we present, through extending previous efforts, an approach to eliciting stuttered speech in laboratory settings. Overall, we show that it is possible to elicit a near-equal distribution of unambiguously stuttered and fluent utterances during the production of single words by leveraging stuttering anticipation. Future studies can use this approach to get closer to identifying the differences between stuttered versus fluent speech at all levels of the system so that we can continue to unravel the mystery of stuttered speech production.

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