

THE VARIABILITY OF STUTTERING  
AND INFLUENTIAL  
FACTORS

by

KAYLA SHERBERT

ANTHONY BUHR, COMMITTEE CHAIR  
HYUNJOO YOO  
EVGUENIA MALAIA  
PHILIP GABLE

A THESIS

Submitted in partial fulfillment of the requirements for the degree of  
Master of Science in the Department of Communicative  
Disorders in the Graduate School of the  
University of Alabama

TUSCALOOSA, ALABAMA

2020

Copyright Kayla Sherbert 2020  
ALL RIGHTS RESERVED

## ABSTRACT

Stuttering is a disorder of speech fluency that is not well understood, in part due to its variable nature. Although a number of factors have been found to contribute to this variability, previous research has often been retrospective or experimental. In this study, forty-one college students completed a survey three times a day for at least two weeks. Each participant evaluated their experiences regarding their own speech fluency, affective state, and willingness to approach. It was expected that affective state would be associated with speech fluency as well as willingness to approach. The main finding of the study was that dimensions of affect (i.e., arousal and mood) were significantly associated with speech fluency, particularly in the morning compared to the afternoon or evening. Results are interpreted to suggest that the positive relation between speech fluency and affect could be outcomes of a common physiological state, a finding that could have important implications for fluency disorders such as stuttering.

## ACKNOWLEDGEMENTS

I am pleased to have this opportunity to thank everyone that invested time and energy into helping me complete this manuscript. I am most thankful to Anthony Buhr, the chairman of this thesis, for guiding me through every step of this project. I would also like to thank all of my committee members, Hyunjoo Yoo, Evguenia Malaia, and Philip Gable for their expertise, valuable input, and support of this project from the very beginning. I would like to thank Ashlyn Coats and Kourtney Jacobowski for participating in the initial creation of this study, and Kate Noble Hall and Celeste Mayhall for participating in the continued development of the project by providing pilot data. I am certainly indebted to every University of Alabama student that volunteered to be participants in this study. Thank you for your participation.

Lastly, I would like to thank my family, friends, and fellow graduate students for their consistent support and encouragement. It is because of them that I had the strength to persevere in the times that this project demanded much of me.

## CONTENTS

ABSTRACT.....	ii
ACKNOWLEDGEMENTS .....	iii
LIST OF TABLES .....	vi
LITERATURE REVIEW .....	1
Stuttering Background .....	1
Variability of Stuttering .....	4
Temperament .....	7
Approach and Avoidance.....	7
Clinical Implications of Variability .....	9
The Present Study .....	10
Expected Findings.....	11
METHODS .....	12
Participants.....	12
Procedures.....	12
Preliminary Data .....	14
Data Reduction.....	15
Statistical Approach .....	16
RESULTS .....	17
DISCUSSION.....	21
Clinical Implications .....	23

Limitations .....	24
Future Directions .....	25
CONCLUSION.....	26
REFERENCES .....	27
APPENDIX.....	31

LIST OF TABLES

1. Affective category by level of speech fluency ..... 17

## LITERATURE REVIEW

Fluency is an important feature of efficient communication between speaker and listener. A speaker's speech fluency is impacted by a number of factors that change over time, meaning fluency is a highly variable phenomenon (Yaruss, 1997). An important issue relating to variability of speech fluency, especially when considering a communication disorder, is that the level of fluency is often unpredictable. This unpredictability can cause great difficulty for both a person with a fluency disorder as well as those who provide therapeutic services for them. Stuttering is a particular type of fluency disorder that usually begins in childhood, and for many people, persists into adulthood (Yairi & Ambrose, 2005). This variability in stuttering can contribute to many of the negative social stigmas surrounding stuttering (Boyle, 2015), and can present a challenge for therapists in diagnosis and evaluation of treatment. Many factors have been identified that influence this variability (e.g., Jackson, Tiede, Beal, & Whale, 2016), and thus there is a tremendous need to better understand how these factors influence the experience of stuttering. By doing so, fluency disorders, such as stuttering, can have more accurate diagnoses and effective treatments.

### **Stuttering Background**

Stuttering is categorized as a disorder of fluency. Traditional definitions of stuttering include the presence of "interruptions" in a person's speech (Bloodstein, 1995). However, there has been much disagreement in how to define stuttering, mostly because deviations from normally fluent speech are themselves hard to define. Therefore, traditional definitions of stuttering have some difficulty distinguishing stuttering from normal disfluency (e.g., Johnson,



1959). For example, there is the question about whether stuttering is defined by frequency of disfluency, reflected in standard scores such as on the Stuttering Severity Instrument (SSI; Riley & Bakker, 2009) or by a subjective feeling of loss of control by the speaker (WHO, 2001).

Readily observable characteristics of stuttering include syllable repetitions, prolongations, and stoppages in the flow of speech. More subtle characteristics associated with stuttering include abnormal speech breathing, breaks in vocal fold vibration, and muscle tension (Bloodstein, 1995). Stuttering can be accompanied by negative emotional factors, as people who stutter often have negative feelings of stuttering and feel it is something of which to feel ashamed (Manning, 2017). This is often coupled with a feeling of inadequacy and can have a negative impact on the quality of life of people who stutter (Daniels, 2004).

A persisting problem in learning more about stuttering concerns the variability of stuttering. For example, the onset of stuttering in the preschool years marks an early change from absence of stuttering to onset of stuttering behaviors (Yairi, 2004). Determining the onset of stuttering can be quite difficult, however, due to the retrospective nature of reporting the behaviors present at onset by parents. In fact, early information regarding onset was reported by parents weeks or months after the onset of stuttering (Johnson, 1959), although more recently, longitudinal studies have been successful in identifying stuttering days or weeks after its onset (Kefalianos et al., 2014; Yairi, 2004). However, research suggests that the age of onset can be relatively variable, with 95% of developmental stuttering cases appearing before the age of four, and 40% of those reported as sudden onsets, within two to three days (Yairi, 2004). Although most children who begin stuttering in the preschool years recover within a few years, early childhood stuttering is marked by substantial variability. However, factors that underlie this variability are still not well understood.

It is paramount to understand that stuttering, as a communication disorder, is only one type of disfluency. Non-stuttered disfluencies, such as verbal fillers (i.e., filled pauses), revisions, and whole word repetitions, are common among typical speakers, as they often provide extra time for the speaker to plan or modify an utterance. One model that accounts for such disfluencies in all speakers is the EXPLAN theory, which attributes fluency breaks to asynchronies between planning and execution, each of which are treated as separate operations synonymous with the linguistic and motor domains of speech (Howell, 2004). Disfluency is explained as asynchrony between planning and execution, where linguistic processes are too slow to provide a plan to the motor domain when needed for execution. The resulting breaks in fluency are common with normally fluent speakers, but differ from stuttered disfluencies in that a speaker has little or no trouble executing that plan in articulation.

Despite such differences, stuttered and non-stuttered disfluencies share much in common, as the factors that trigger the presence of disfluency behaviors are similar for each (Richels et al, 2010). For example, greater sentence length or syntactic complexity is more likely to elicit disfluencies in overt speech for both stuttering and non-stuttering speakers, but this manifests as stuttered disfluencies in people who stutter (Buhr & Zebrowski, 2009). In addition, all types of disfluencies tend to cluster at the beginning of utterances (Richels et al., 2010). Although overt disfluencies differ between people who do and do not stutter, at least some factors that influence their manifestation in overt speech appear to be similar. Therefore, determining which factors correlate with changes in normal disfluency can provide valuable information about both typical speakers and those who stutter.

## **Variability of Stuttering**

As mentioned above, speech fluency is highly variable, meaning that changes in disfluency can be observed within a speaker both across the hours of a day and the days of the week. Previous studies have found that certain factors are correlated with higher variability in the number of disfluencies. Two important factors, identified by Yaruss (1997), are speaking task and speaking situation. Yaruss provided children who stutter with various speaking tasks that differed in terms of conversational dialogue versus monologue speech and different speaking situations that were associated with time pressure or not. It was reported that tasks involving speaking with another person, such as parent-child interaction and play, showed 6.31 and 6.67 average disfluencies. This average was greater than for monologue tasks, such as picture description or story retell, which showed 5.45 and 5.87 average disfluencies, respectively. Situations with more time pressure, such as when the child was asked more frequent questions, interrupted, and rushed, were more likely to elicit disfluencies. This finding suggests that introducing time pressure as a variable can elicit more disfluencies across speaking tasks. Variability across situations and tasks was greater than within situations or tasks, suggesting that variability in stuttering may be attributed to differences in speaking tasks or situations.

Other factors were studied by Constantino, Leslie, Quesal, & Yaruss (2016) in adult participants across a fourteen-day period. It was found that people who presented with the greatest amount of variability reported more negative feelings about their stuttering in the Overall Assessment of the Speaker's Experience of Stuttering (OASES; Yaruss & Quesal, 2006). These findings suggested that unpredictability, resulting from the variability from day to day, causes a heightened uneasiness about a person's stuttering, and thus an adverse effect on speech fluency.

Emotion is another factor that has been suggested to correlate with variability of speech fluency. For example, speakers often have more speech disfluencies when experiencing heightened emotion or feelings of anxiety (e.g., Jackson et al., 2016). Individual differences also exist in emotional reactivity to stressors as well as the ability to regulate emotion, as indicated by parent response on standardized tests such as the Child Behavior Questionnaire (Rothbart et al., 2001). Karras et al. (2006) reported that children who stuttered were rated as more emotionally reactive and less able to regulate emotions compared to parents of children who did not stutter. Thus, two important factors related to emotion are an individual's unique response to perceived stressors in the environment and how that individual copes with change in emotion (Arnold et al., 2011).

Emotional arousal can be measured along dimensions of high or low magnitude or positive or negative valence. The magnitude of emotional arousal can affect speech fluency and stuttering variability (Jones, Conture, & Walden, 2014). For example, a person who stutters is likely to experience a greater amount of disfluency when they are both angry and excited. These emotions are characterized as both high arousal and high approach. Therefore, it is the state of arousal that causes changes in a person's fluency, not necessarily whether the emotion they are feeling is positive or negative. However, although abrupt changes in emotion can be acutely experienced in terms of emotional arousal, one's general sense of whether their own affective state is positive or negative is known as mood. Clark & Watson (1988) investigated change in mood in conjunction with events in a typical day, with the most salient finding being that social events had the highest correlation to positive affect (p. 304). However, attempts at linking speech fluency to emotion are challenging because of the difficulty of controlling for other factors that might have an impact on speech fluency. For example, events within the environment could lead

both to changes in speech fluency and mood, with mood exerting a causal influence on speech fluency (Buhr et al., 2016).

Emotions can be subdivided as discrete categories and previous research has indicated a clear difference in different types of positive and negative emotions (Harmon-Jones et al., 2016). Anger, though a negative emotion, would be classified as high-approach, whereas fear, also a negative emotion, would be classified as low-approach (Carver & Harmon-Jones, 2009). Thus, when considering the drive to approach or avoid in terms of stuttering (Sheehan, 1954), it is important to distinguish between level of arousal (i.e., drive) and valence, as positive and negative emotions can be differentiated as high or low approach.

Emotions are not only subject to variability within a person, as they respond to and are regulated by emotional arousal, but changes in emotion can also be triggered by factors within the environment. Stuttering behaviors increase when the risks associated with the speaking situation increase, such as with an audience. This effect becomes greater when that audience includes people of authority (Jackson et al., 2016; Sheehan, Hadley, & Gould, 1967), as a person could experience an increased fear/anxiety response associated with the risks of speaking in stressful situations. Thus, the variability of emotion within an individual can be impacted both by factors present in the environment, particularly those that might be unfamiliar or unpredictable, and the natural proclivities of the individual to respond to those factors. A current model of stuttering that takes both into account is the dual diathesis-stressor model (Walden et al., 2012), which accounts for change in stuttering as the activation of a genetic predisposition for stuttering by a stressor in the environment. According to this model, a person with a diathesis for stuttering would be vulnerable for speech disruption when emotional stressors are present in the environment. It is possible, however, that the link between speech fluency and emotional arousal

is not causal, but rather each could be an effect of the presence of the stressor. Importantly, because the presence of any stressor is unpredictable, it can exert a variable impact on behavior.

## **Temperament**

Traits that reflect the nature of an individual is known as temperament. As a “subdomain of personality,” temperament has foundations in emotional and biological systems (Evans & Rothbart, 2007, p. 869). It reflects an individual’s tendency to respond in particular ways to stressors in the environment. Kagan, Reznick, and Gibbons (1989) investigated temperament in children, finding that highly reactive infants who became more stressed in certain situations were more likely to be fearful in new situations. Often, animals in new or fearful situations show immobility, which appears in humans as speech restraint (Kagan, 1997). Evans & Rothbart (2007) described temperament in adults using a six-factor model: orienting sensitivity, effortful control, affiliativeness, extraversion, non-aggressive negative affect, and aggressive negative affect. Though a person’s temperament may be visible in different ways as an adult, temperament is established in infancy and is maintained over a lifetime (Kagan, 1997). Because these characteristics are persistent throughout a person’s life, they are aspects of the person’s personality that can influence their reactions to daily situations. Temperament can impact speech fluency, as dimensions of temperament could influence to what extent a person might choose to approach an unfamiliar social situation. However, it is unclear whether temperament differs with people who stutter and people who do not (Kefelianos, 2016).

## **Approach and avoidance**

Two general models account for the variability of behavior through competing drives as a means of regulating behavior. What these models have in common is the distinction between approach and avoidance drives. The first model is referred to as the double approach-avoidance

model (Sheehan, 1954). This model suggested that stuttering results from a conflict between the desire to approach someone or something and the simultaneous desire to avoid that person or thing. As an extension of this model, Sheehan argued that stuttering was associated with *double* approach-avoidance when the person is faced with the situation of possibly having both positive and negative consequences regardless of whether they choose to approach or avoid. As Gattie (2012) explained, if a person who stutters chooses to speak, they are able to get their message across but with the consequence of stuttering. If they choose to not speak, however, they have the positive consequence of not revealing to their speaking partner that they stutter but deal with the negative consequence of not sharing their message. It is assumed that the existence of such conflict can manifest in overt speech as stuttering.

Approach and avoidance drives can change when factors within a person's environment change. For example, when the possible speaking partner is a friend, a person's tendency to approach may increase, because the friend is familiar. Approach drives can also be influenced by factors such as changes in mood. Carver (2006) has described this approach-avoidance system as the system that regulates action, meaning that it is the desire to approach or avoid that drives a person to act. This action system is thought to be directly related to the affect system, in that both positive and negative affect are an indication of either success or failure of achieving a desired action. This model can be applied to speech fluency, as it suggests that a person's decision to approach or avoid a speaking situation can be influenced by the desire to either avoid experiences that might bring about negative affect or seek out experiences that bring about positive affect. Further research can help to flesh out the relationship between competing approach and avoidance drives and their impact on speech fluency.

## **Clinical Implications of Variability**

Constantino et al. (2016) suggested that stuttering variability has many implications for clinical practice. First, it is important to understand that variability can be the basis for many of the social problems faced by people who stutter. The person who stutters may develop a false sense of hope when they experience a period of fluency and then be immediately disappointed when that fluent moment diminishes and stuttering increases. This inconsistency, or variability, can also give a person's conversational partners the impression that stuttering is something that could be overcome with more conscious effort. These experiences often impact the quality of life of a person who stutters, leading them to be fearful of speaking to others.

Another implication of such variability is the fact that it can be misleading when evaluating a client's progress. Because of this variability, what a clinician sees in the clinic on any given day may not be a true representation of that person's fluency. This leads to a difficulty in knowing whether the gains observed in therapy are a result of the therapy or simply an artifact of variability. Another factor to consider is that many people who stutter have ways to hide stuttering by avoiding certain words or speaking situations. This can also be an obstacle evaluating speech fluency or the efficacy of therapy. Clinicians must be aware of these implications of variability and be prepared to address them in clinical settings.

Clinicians must use caution when evaluating a client's progress and employ measures that can provide accurate information about the client's fluency. This same idea can also be applied to assessment, both in adults and children who stutter. Specifically with children, it is possible to evaluate a child based on parental concern yet see no evidence of stuttering on the evaluation day. However, that same child could show evidence of stuttering in an evaluation one day later. This situation produces a need for clinicians to understand the variable nature of



stuttering and perform comprehensive and extended assessments. Both for clinical assessment and progress measurement, the nature of stuttering variability is extremely important for treatment of stuttering. It is essential that clinicians understand which factors contribute to and influence stuttering variability for implementation of effective intervention for clients who stutter.

### **The Present Study**

Studies concerned with variability of stuttering have been either retrospective or experimental in nature. Both Constantino et al. (2016) and Yaruss (1997) conducted experimental studies by measuring speech disfluencies in both adults and children across a range of tasks that differed in linguistic complexity. Other studies have asked clients or parents of clients to recall prior events as a means of identifying factors that may have impacted speech fluency (Karass et al., 2006). Although these studies are helpful in identifying factors that can affect variability of stuttering, such study designs are unable to take into account other important factors that might affect speech fluency in the moment, such as affect and familiarity with the conversation partner. These factors might also be influenced by time of the day and temperament.

Further study is needed to determine what factors relate to the variability of speech fluency. The present study used the term “affect” to refer to the dimensions of arousal and mood as well as categories such as “happy,” “sad,” or “neutral.” This study investigated to what extent variability of speech fluency is influenced by affect, speaking partner, approach, and time of day. Although the ultimate goal of this research is to learn about the variability of stuttering as a fluency disorder, because of presumed common sources of variability in the speech disfluency of both people who do and do not stutter, one can learn much about the variability of speech

disfluency in general before undertaking a study of stuttering. Therefore, determining which factors are associated with speech disfluency in general can provide insights about stuttering.

### **Expected Findings**

It was hypothesized that both affect and approach would be associated with a person's level of speech fluency. Thus, it was expected that affective dimensions of arousal and mood would be associated with speech fluency, and that the willingness to approach a friend, stranger, or non-social activity would also be associated with speech fluency. Secondly, it was hypothesized that relations among these factors would change depending on the time of the day. Such findings were expected to have implications for treatment, as focusing on any of these factors could have an impact on fluency behaviors. Lastly, analyzing fluency in the moment rather than experimentally or retrospectively was expected to provide important insights into stuttering variability.

## METHODS

### **Participants**

Participants in this study were a sample of forty-one current undergraduate students at the University of Alabama. The sample consisted of one student that stuttered and forty students that did not. The mean age was 21.7 years, and the sample consisted of thirty-three females and eight males. All participants signed a consent form approved by the Institutional Review Board at the University of Alabama. At the completion of the study, participants received compensation in the form of a \$20 gift card for participating.

### **Procedures**

Students were recruited to participate in the study through advertising in their classes. Students were asked to provide the researchers with their email address if interested and were contacted by email to provide information on enrollment. Once enrolled in the study, students were asked to complete the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007) via a Qualtrics form to obtain a measure of temperament/personality. Participants' responses on the ATQ were scored according to four main factor-scales (Negative Affect, Extraversion/Surgency, Effortful Control, and Orienting Sensitivity) that were each subdivided further into smaller scales. Factor scales were scored by adding the Likert scores for all of the items belonging to that factor scale and dividing by the total number of items in that factor scale. It was discovered post-data collection that the last 6 questions of the ATQ were not included in the Qualtrics survey and therefore, the participants were unable to answer them. However,

because the ATQ is scored by calculating a mean, one or two missing questions per domain was not assumed to have a significant impact on scores.

After participants completed the ATQ, they were instructed to download the mobile application Personal Analytics Companion (PACO). The application was available both for iOS and Android users. After downloading the application, the participants were asked to begin responding to the PACO survey. Once enrolled in the study, participants received a notification to complete the survey three times a day (8:00 AM, 2:00 PM, and 8:00 PM) for a minimum of fourteen days. When the notification was received, the participants had a maximum of two hours to open the application and respond to the survey for their response to be included in the dataset. Survey data was recorded on the PACO online software and exported to a spreadsheet for analysis. All survey questions were presented at once on the same page. Each question except for the first had a Likert scale of seven and the participant was required to check the box that best represented their response on the scale. The survey questions were as follows:

1. Which of the following fits your current mood? (click any that apply) Choices were angry, eager, happy, sad, or neutral.
2. Click the circle that best describes your current mood. (unpleasant to pleasant)
3. Click the circle that best describes how energetic you feel. (calm to excited)
4. At this moment I would feel comfortable trying something new. (not at all to very much)
5. At this moment I would feel comfortable asking a stranger a question. (not at all to very much)
6. At this moment I would feel comfortable asking a close friend for advice. (not at all to very much)
7. Please rate your overall level of speech fluency. (very disfluent to very fluent)

For the purpose of this study, we assessed affect using a multidimensional measure of both arousal (high to low) and mood (negative to positive). Additionally, participants were asked to state which category fit their affective state using terminology representative of low approach emotions versus high approach emotions according to suggestions from the Discrete Emotions Questionnaire (Harmon-Jones et al., 2016). In addition to affective dimensions of mood and arousal, survey questions also addressed approach/avoidance according to the likelihood of approaching a stranger, friend or non-social activity, such that if someone rated their likelihood of approach as low, then avoidance would be higher. Finally, participants were asked to rate their speech fluency to assess appraisal of their own fluency. Temperament was addressed through the use of the Adult Temperament Questionnaire (ATQ).

### **Preliminary Data**

A preliminary acquisition of data from two participants over a one-month period in October of 2018 allowed for a power analysis to be conducted to determine how many participants would be needed to address study questions. Pilot data was collected by two undergraduate student volunteers and one member of the research team. The two students and research team member answered five questions through PACO three times a day for a month. Changes were made to the survey questions after the two students completed the study. A statistical application called G\*Power was used to conduct power analyses of the pilot data. Alpha was set at 0.05 and power was set at 0.80 (1 – beta). First, to evaluate whether two dependent measures are related to each other (i.e., one can predict one from the other), an analysis for linear multiple regression with 3 predictors was used. Based on preliminary analysis for the relation between Fluency and Affect, the  $R^2 = 0.56$  resulted in a total sample size of 15 participants needed to determine that perceived levels of speech fluency and affect are

significantly related. Alternatively, to determine whether perceived level of drive to approach a stranger would differ from perceived level of drive to approach a friend, an analysis for a repeated-measures ANOVA with 3 participants, and 3 repeated-measures corresponding to Time of Day, was conducted. Based on preliminary data, an effect size of 0.56 was calculated, which translated to a total of 33 participants needed to conduct the study. Overall, 41 participants were enrolled in the study, which provided a large enough sample size to evaluate study hypotheses.

### **Data Reduction**

Because the study was completed online, and thus not under direct supervision of study investigators, participants were asked to participate in the study for at least 14 days to ensure a sufficient amount of data would be acquired from each participant. This allowed a couple days to work through any problems the participants had as they began the study. Therefore, many of the participants completed the study for more than fourteen days. However, two participants were unable to participate for the full fourteen days. Throughout this process, the researchers assigned a time stamp (1, 2, or 3) for any response within two hours after the notification time or one hour before the notification time. Responses not within this time window were removed and not used in data analysis. A decision was made that participants had to respond to at least 2 out of every 3 prompts to be included in the dataset, as some participants failed to respond in a timely fashion.

For the measure of affect, participants were allowed to select more than one option for their response. Though most participants only selected one option, there were a few instances where more than one option was selected for a single survey response. However, since there was not enough data with multiple responses for affect to perform a separate analysis, these few combinations were reduced according to four steps. First, most of the data lines with two responses included “neutral” as one of the two. Because this description is a placeholder and

does not give us any information about a person's affect, the decision was made to delete the "neutral" response and replace it with whichever response was additionally provided. A total of 78 combinations of neutral and another option were reduced: 49 combinations of happy-neutral were reduced to "happy", 9 combinations of sad-neutral were reduced to "sad," 10 combinations of angry-neutral were reduced to "angry," and 10 combinations of eager-neutral were reduced to "eager." Second, in situations where "eager" was reported with another option, "eager" was deleted and the other response was used. This decision was made because "eager" implies being energetic, and this domain was addressed in the following question with arousal state. A total of 34 eager-happy combinations were reduced to "happy." Third, when more than one option was selected at the same time that clearly did not make sense together (i.e. when "happy" and "sad" were selected at the same time), the decision was made to replace these responses with "neutral." There were a total of 8 combinations that were reduced to "neutral." Finally, 7 sad-angry combinations were reduced to "sad," as this was a more common affective state. Overall, 127 combinations were reduced to a single response option for statistical analysis, corresponding to nearly 7.5% of the total number of 1685 responses.

### **Statistical Approach**

Mixed model analysis using R statistical software (R Development Core Team, 2009) with the statistical package lme4 (Bates & Mächler, 2009) was used to evaluate study hypotheses. Degrees of freedom for planned comparisons were calculated based on the Satterthwaite approximation using the statistical package lmerTest (Kuznetsova, Brockhoff, & Christensen, 2012). For each model, independent variables of interest were used in the base model to predict the dependent variable. Interactions were included in a model if significant or otherwise removed.

## RESULTS

Self-reported affect was evaluated first. Because affective qualities of Angry, Eager, Happy, Neutral, and Sad were nominal and did not have a natural order or ranking, statistical analysis was not performed. Rather, Table 1 presents each affective quality and its co-occurrence with self-reported fluency. As can be seen in Table 1, Neutral and Happy received the most responses, followed by Eager, Sad, and Angry. In addition, the most responses for level of speech fluency ranged from 4-7, but particularly for 6-7. This suggests that most participants experienced positive or at least neutral affects most of the time, and that when they did, they experienced very high levels of speech fluency. In fact, participant responses to Happy and Neutral at 6-7 of speech fluency level accounted for 1138 of the of the 1730 responses, or about 66% of all responses.

**Table 1.** Affective category by level of speech fluency.

Affect	Fluency Level							Total
	1	2	3	4	5	6	7	
Angry	2	1	1	5	12	7	4	32
Eager	0	1	2	9	14	37	39	102
Happy	0	3	9	32	84	262	320	710
Neutral	6	10	32	75	118	266	290	792
Sad	3	8	7	15	18	25	13	89
Total	11	23	51	136	246	597	666	1730

*Note:* Fluency level ranges from 1= “not at all fluent” to 7= “very fluent”



Next, three models were employed to evaluate study hypotheses. For each model, both Participant and Month were used as random factors, and Fluency was used in all three models as the dependent variable. In addition, each model included Gender (male or female) and Weekend (versus weekday) as potential factors of interest.

First, to evaluate the hypothesis that self-judgements about speech fluency are influenced by affective experience, both Arousal and Mood were used as predictors. In addition, Time was used as a predictor, and potential interactions between Time and both Arousal and Mood were considered. Results showed main effects for both Arousal,  $\beta = 0.095$ ,  $t(1705) = 4.231$ ,  $p < .001$ , and Mood,  $\beta = 0.315$ ,  $t(1698) = 11.627$ ,  $p < .001$ , indicating that participants experienced greater levels of Arousal and a more positive Mood with greater levels of speech fluency. In addition, a main effect was found for Time, with both Time 2 (afternoon),  $\beta = 0.800$ ,  $t(1684) = 4.500$ ,  $p < .001$ , and Time 3 (evening),  $\beta = 0.779$ ,  $t(1683) = 4.452$ ,  $p < .001$ , being associated with greater levels of speech fluency compared to Time 1 (morning). This indicated that participants tended to feel much less fluent in terms of their speech in the mornings. To this end, the interactions between Time and both Arousal and Mood were significant, indicating that the relation between speech fluency and Arousal was significantly greater in the morning compared to the afternoon,  $\beta = 0.056$ ,  $t(1683) = -2.000$ ,  $p = .046$ , and evening,  $\beta = 0.059$ ,  $t(1685) = -2.058$ ,  $p = .040$ , and the relation between speech fluency and Mood was significantly greater in the morning compared to the afternoon,  $\beta = 0.073$ ,  $t(1682) = -2.052$ ,  $p = .040$ , and the evening,  $\beta = 0.080$ ,  $t(1685) = -2.213$ ,  $p = .027$ . Finally, there was no effect of Gender, but there was an effect for Weekend, with participants experiencing less speech fluency on the weekend compared to weekdays,  $\beta = 0.132$ ,  $t(1680) = -2.879$ ,  $p = .004$ . However there was no significant interaction between Weekend and Time.

Next, to evaluate whether affective experience (Mood and Arousal) and speech fluency differ between a friend or a stranger, both Stranger and Friend as well as a Non-Social task were used as predictors for speech fluency. In addition, potential interactions were considered. Results showed that both Stranger,  $\beta = 0.063$ ,  $t(1711) = 2.764$ ,  $p = .006$ , and Friend,  $\beta = 0.271$ ,  $t(1710) = 8.380$ ,  $p < .001$ , as well as Non-Social,  $\beta = 0.074$ ,  $t(1702) = 3.471$ ,  $p < .001$ , positively related to speech fluency. This suggests that the willingness to engage with the world, whether friends, strangers, or neither, is associated with feelings of increased speech fluency. In addition, the interaction between Friend and Time was significant, such that the relation between approaching a friend and speech fluency was significantly less pronounced in the afternoon,  $\beta = .165$ ,  $t(1684) = -5.488$ ,  $p < .001$ , and evening,  $\beta = 0.191$ ,  $t(1684) = -6.380$ ,  $p < .001$ , compared to the morning. This indicates that if a student was willing to approach a friend in the morning, this was very much associated with whether they experienced higher speech fluency. This could mean, for example, that the impact of speech fluency on willingness to talk to friends, either in one's apartment or in class, was most salient in the mornings. To this end, the interaction between Friend and Arousal was also significant,  $\beta = 0.024$ ,  $t(1698) = 3.201$ ,  $p = .001$ , indicating that the relation between willingness to approach a friend and speech fluency was greater as arousal increased. Another way of saying this is that when people are feeling higher levels of arousal, they experience more speech fluency, they have a greater willingness to approach a friend, and this is particularly the case in the morning.

Finally, temperament was evaluated by looking at the relations among factor scales of the Adult Temperament Questionnaire (ATQ) and speech fluency. Results showed that there were no significant relations, but the effect of Extraversion approached significance. This effect was therefore looked at further with respect to the previous finding that the relation between

willingness to approach a friend and speech fluency was greatest in the morning. A 2-way interaction revealed that the relation between speech fluency and Time was greater for participants who had higher ratings of Extraversion,  $\beta = 0.663$ ,  $t(1681) = 2.260$ ,  $p = .024$ , and a 3-way interaction revealed that the effect of Extraversion on the relation between willingness to approach a friend and speech fluency was greatest in the morning,  $\beta = 0.104$ ,  $t(1681) = -1.996$ ,  $p = .046$ .

## DISCUSSION

Overall, results are consistent with hypotheses. First, results suggest that the motivation to approach, as indicated by affective dimensions of Arousal and Mood, was highly related to speech fluency. This might be interpreted to suggest that when people are feeling more fluent in terms of their own speech, they are more likely to be in an approach state. Another way of saying this is that when people find themselves in a more positive mood and are more energetic, they also happen to feel more fluent. Thus, there might not be a cause-effect relation between one's approach state and speech fluency, but each could be markers of the same underlying affective state of positivity toward one's self and the social environment, which could itself be influenced by a number of factors.

A major finding of the study was that time of day was the most reliable predictor of speech fluency. Participants reported greater levels of speech fluency at Time 2 (afternoon) and Time 3 (evening) than at Time 1 (morning). In addition, the lower level of speech fluency in the morning was associated with lower arousal and a less positive mood. This indicates that participants in the study (i.e., college students) experienced the morning differently than the rest of the day. This could be due to the fact that in the mornings, participants in the study, having recently woken up, needed time to acclimate to the day. This finding is not surprising and is consistent with research that suggests that sleep and mornings are associated with lower arousal in general (Tassi & Muzet, 2000).

Findings from this study with adults showing that lower levels of arousal were associated with decreased speech fluency might at first appear to be inconsistent with previous studies

examining emotional arousal in preschool-age children. Findings from such studies indicate that parents report more stuttering when their child is in a state of high emotional arousal, whether positive or negative, for example, when experiencing more intense emotions such as excitement or anger (e.g., Karrass, et al., 2006; Jones, Conture, & Walden, 2014). Participants in this study generally did not experience any high levels of arousal, as indicated by the high frequency of neutral and happy affective states. Though previous research has shown that an overly heightened arousal level can lead to disfluency in children, the results from this study suggest that the same can happen when a person reaches the opposite end of the continuum with a very low arousal level. In other words, some arousal might be important for speaking behaviors to be fluent, but this is not the case for high magnitudes of arousal. Overall, results from both children and adults suggest that departures from typical levels of arousal, whether extreme or not, are associated with less speech fluency.

Another finding is that speech fluency was perceived to be lower on the weekend compared to the weekday. This suggests that the routine for participants differed Monday through Friday versus Saturday and Sunday. For example, it is possible that participants remained in bed for a longer time on the weekend and interacted with different people at different times compared to the weekdays. It is also possible that overall levels of arousal were reduced on the weekend, and this was associated with lower levels of perceived speech fluency.

One other finding from the study is that the willingness to approach a friend, approach a stranger, and engage in a non-social task were all associated with greater speech fluency, but the effect of approaching a friend was greater in the morning compared to the afternoon and evening. This was also associated with higher ratings of extraversion. However, no interactions were found for either approaching a stranger or engaging in a non-social task, indicating that there

might be something unique about approaching a friend. One possibility is that the decision about whether to approach a friend is more dependent on how one feels in the moment compared to approaching a stranger. It is also possible that, in the mornings, most participants tended to be with friends to a greater extent than with strangers, and thus presented more opportunities to approach or not, in contrast to strangers or non-social tasks.

Perhaps the most interesting finding of the study was that time of the day had the most pronounced impact on fluency as well as affective states of approach, including arousal and mood. This is an intriguing finding because a person's routine across a day has not been directly addressed in research on fluency and stuttering, particularly for adults. This finding has important implications for all speakers because these patterns were discovered in a sample of primarily fluent speakers. Thus, it would seem that for speakers in general, speech fluency is perceived to be lowest at the beginning of the day. Whether or not a person actually is less fluent in the morning, the fact that speakers perceive this suggests they would be less inclined to talk, particularly to a friend.

### **Clinical Implications**

Findings from this study provide substantial information about the variability of stuttering, as it appears that variability of speech fluency is not just from one person/situation to another, but also from one time of the day to another. Results suggest that for someone just beginning treatment for fluency, a therapy session in the morning may not be the most ideal situation to foster their success. From these results, we would suggest beginning fluency therapy in the afternoon when the person's arousal level is higher and they are also at a greater likelihood of demonstrating positive affect. However, the implications are different for someone who has received treatment services for a significant period of time and is at the generalization stage

when they are attempting to apply techniques consistently in everyday life. For these clients, our results suggest that it may be more beneficial to have therapy sessions in the morning to practice fluency techniques at a time when their fluency is naturally decreased due to low arousal level, they typically exhibit less positive affect, and they have a lower willingness to speak to others. Results also suggest that by improving these factors, we may be able to indirectly improve fluency.

### **Limitations**

Although this study resulted in some interesting findings, there were some limitations to note. First, our sample was restricted to college students and therefore is not representative of the general population at large. College students often have a different lifestyle than children and adults, which typically involves staying up late at night and sleeping in later in the morning. Because many of the data points that were missed were in the morning, the tendency to not respond to the survey could be related to not wanting to engage.

Another limitation is that participants completed the survey at different times of the year: some completed the study in the summer while others completed it during the fall and winter months. Ideally, all participants would have completed the study in the same two-week time frame, but since this was not an option, we included “month” as a random factor in data analysis.

Lastly, not all participants responded to the prompt all three times per day for two weeks, and this lack of consistency meant that some participants contributed more data than other participants. However, this was accounted for by using each participant as a random factor in the model. In addition, participants were required to respond to at least two out of three prompts over the course of the two-week time period to be included in the study.

## **Future directions**

A future study would be beneficial to investigate these same factors in people who stutter. This would determine to what extent findings from this study would translate to people who stutter, or whether people who stutter are unique in any way. Another idea for a future study concerns how changes in the daily routine of other people in the general population might change the effect of time on fluency. For example, if people who generally started their day extremely early in the morning were to complete this study, the results might show an opposite effect of time, where they are less fluent in the evening due to a reduced arousal level as compared to the college students.

Finally, it is also important to note that ratings of fluency in this study were the participant's own subjective feelings regarding their fluency rather than objective data on speech fluency. A further study could obtain an objective measure of speech fluency at specified times throughout the day to determine if a person's subjective rating of their fluency is truly representative of their actual speech fluency. These thoughts would be interesting additions to the findings from this study and provide more information on how time of day can affect fluency in various people.



## CONCLUSION

The purpose of this study was to explore different factors that contribute to the variability of stuttering and how these factors influence a person's speech fluency throughout the day and week. Forty-one college students participated in the study by answering a series of survey questions three times a day for two weeks. It was concluded that participants experienced lower levels of arousal and affect in the morning, which coincided with lower levels of speech fluency. This is something that must be taken into account when working with a person who stutters, as time of day may have a substantial impact on their speech fluency.

## REFERENCES

- Arnold, H. S., Conture, E. G., Key, A. P. F., & Walden, T. (2011). Emotional reactivity, regulation and childhood stuttering: A behavioral and electrophysiological study. *Journal of Communication Disorders, 3*, 276-293. <https://doi.org/10.1016/j.jcomdis.2010.12.003>
- Bates, D., & Mächler, M. (2009). lme4: Linear mixed-effects models using Eigen and Eigenpack. R package version 3.4.3.
- Bloodstein, O. (1995). *A handbook on stuttering* (5th ed.). San Diego, CA: Singular Publishing Group, Inc.
- Boyle, M. P. (2015). Identifying correlates of self-stigma in adults who stutter: Further establishing the construct validity of the Self-Stigma of Stuttering Scale (4S). *Journal of Fluency Disorders, 43*, 17-27. <https://doi.org/10.1016/j.jfludis.2014.12.002>
- Buhr, A., & Zebrowski, P. (2009). Sentence position and syntactic complexity of stuttering in early childhood: A longitudinal study. *Journal of Fluency Disorders, 34*, 155-172. [doi:10.1016/j.jfludis.2009.08.001](https://doi.org/10.1016/j.jfludis.2009.08.001)
- Buhr, A. P., Scofield, J., Eyer, J. C., & Walden, T. A. (2017). Cued self-awareness and speech fluency. *Speech, Language and Hearing, 20*(4), 187-195. <http://dx.doi.org/10.1080/2050571X.2016.1277455>
- Carver, C. S. (2006). Approach, avoidance, and the self-regulation of affect and action. *Motivation and Emotion, 30*, 105-110. <https://doi.org/10.1007/s11031-006-9044-7>
- Carver, C. S., & Harmon-Jones, E. (2009). Anger is an approach-related affect: Evidence and implications. *Psychological Bulletin, 135*(2), 183-204. DOI: 10.1037/a0013965
- Clark, L. A., & Watson, D. (1988). Mood and the mundane: Relations between daily life events and self-reported mood. *Journal of Personality and Social Psychology, 54*, 296-308. DOI: 10.1037/0022-3514.54.2.296
- Constantino, C. D., Leslie, P., Quesal, R. W., & Yaruss, J.S. (2016). A preliminary investigation of daily variability of stuttering in adults. *Journal of Communication Disorders, 60*, 39-50. <https://doi.org/10.1016/j.jcomdis.2016.02.001>

- Daniels, D. E., Gable, R. M. (2004). The impact of stuttering on identity construction. *Topics in Language Disorders, 24*, 200-215. [https://journals.lww.com/topicsinlanguagedisorders/Abstract/2004/07000/The\\_Impact\\_of\\_Stuttering\\_on\\_Identity\\_Construction.7.aspx](https://journals.lww.com/topicsinlanguagedisorders/Abstract/2004/07000/The_Impact_of_Stuttering_on_Identity_Construction.7.aspx)
- Evans, D. E., Rothbart, M. K. (2007). Developing a model for adult temperament. *Journal of Research in Personality, 41*, 868-888. <https://doi.org/10.1016/j.jrp.2006.11.002>
- Gattie, M. (2012). Stammering as a Conflict in Cognitive Processes. Retrieved from <https://www.semanticscholar.org/paper/Stammering-as-a-Conflict-in-Cognitive-Processes-Gattie/5d3dd9154c41f3800682dd961b4f11af140602e7>
- Harmon-Jones, C., Bastian, B., Harmon-Jones, E. (2016). The Discrete Emotions Questionnaire: A New Tool for Measuring State Self-Reported Emotions. *PLoS ONE, 11*, 1-25. <https://doi.org/10.1371/journal.pone.0159915>
- Howell, P. (2004). Assessment of some contemporary theories of stuttering that apply to spontaneous speech. *Contemporary Issues in Communication Sciences and Disorders, 31*, 122-139. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2231590/>
- Jackson, E. S., Tiede, M., Beal, D., & Whalen, D. H. (2016). The Impact of Social-Cognitive Stress on Speech Variability, Determinism, and Stability in Adults Who Do and Do Not Stutter. *Journal of Speech, Language, and Hearing Research, 59*, 1295-1314. [https://doi.org/10.1044/2016\\_JSLHR-S-16-0145](https://doi.org/10.1044/2016_JSLHR-S-16-0145)
- Johnson, W. (1959). *The onset of stuttering: Research findings and implications*. Minneapolis, MN: University of Minnesota Press.
- Jones, R. M., Conture, E. G., & Walden, T. A. (2014). Emotional reactivity and regulation associated with fluent and stuttered utterances of preschool-age children who stutter. *Journal of Communication Disorders, 48*, 38-51. <http://dx.doi.org/10.1016/j.jcomdis.2014.02.001>
- Kagan, J., Reznick, J. S., & Gibbons, J. (1989). Inhibited and uninhibited types of children. *Child Development, 60*, 838-845. DOI: 10.2307/1131025
- Kagan, J. (1997). Temperament and the reactions to unfamiliarity. *Child Development, 68*, 139-143. <https://doi.org/10.1111/j.1467-8624.1997.tb01931.x>
- Karrass, J., Walden, T. A., Conture, E. G., Graham, C. G., Arnold, H. S., Hartfield, K. N., & Schwenk, K. A. (2006). Relation of emotional reactivity and regulation to childhood stuttering. *Journal of communication disorders, 39*(6), 402-423. <https://doi.org/10.1016/j.jcomdis.2005.12.004>
- Kefalianos, E., Onslow, M., Ukoumunne, O., Block, S., Reilly, S. (2014). Stuttering, temperament, and anxiety: Data from a community cohort ages 2-4 years. *Journal of*

- Speech, Language, and Hearing Research*, 57, 1314-1322.  
[https://doi.org/10.1044/2014\\_JSLHR-S-13-0069](https://doi.org/10.1044/2014_JSLHR-S-13-0069)
- Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2012). lmerTest. R package version 2.0-30.
- Manning, W. H., & DiLollo, A. (2017). Clinical decision making in fluency disorders. Plural Publishing.
- Personal Analytics Companion. <https://pacoapp.com/>
- R Development Core Team. (2009). R: A language and environment for statistical computing. Foundation for Statistical Computing, Vienna, Austria. Retrieved from <http://www.R-project.org>.
- Riley, G. D., & Bakker, K. (2009). *Stuttering severity instrument: SSI-4*. Pro-Ed.
- Richels, C., Buhr, A., Conture, E., Ntouro, K. (2010). Utterance complexity and stuttering on function words in preschool-age children who stutter. *Journal of Fluency Disorders*, 35, 314-331. <https://doi.org/10.1016/j.jfludis.2010.06.001>
- Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child development*, 72(5), 1394-1408. <https://doi.org/10.1111/1467-8624.00355>
- Sheehan, J. G. (1954). An integration of psychotherapy and speech therapy through a conflict theory of stuttering. *Journal of Speech and Hearing Disorders*, 19, 474-482.  
[doi:10.1044/jshd.1904.474](https://doi.org/10.1044/jshd.1904.474)
- Sheehan, J., Hadley, R., Gould, E. (1967). Impact of authority on stuttering. *Journal of Abnormal Psychology*, 72, 290-293. <http://dx.doi.org/10.1037/h0024674>
- Tassi, P., & Muzet, A. (2000). Sleep inertia. *Sleep Medicine Reviews*, 4, 341-353.  
<https://doi.org/10.1053/smr.2000.0098>
- Walden, T.A., Frankel, C. B., Buhr, A. P., Johnson, K. N., Conture, E. G., & Karass, J. M. (2012). Dual diathesis-stressor model of emotional and linguistic contributions to developmental stuttering. *Journal of Abnormal Child Psychology*, 40, 633-644.  
<https://doi.org/10.1007/s10802-011-9581-8>
- World Health Organization. (2001). *The international classification of functioning, disability, and health*. Geneva, Switzerland: Author.
- Yairi, E. (2004). The formative years of stuttering: A changing portrait. *Contemporary Issues in Communication Science and Disorders*, 31, 92-104.<https://www.asha.org/uploadedFiles/asha/publications/cicsd/2004STheFormativeYearsofStuttering.pdf>

Yaruss, J. S. (1997). Clinical implications of situational variability in preschool children who stutter. *Journal of Fluency Disorders*, 22, 187-203. [https://doi.org/10.1016/S0094-730X\(97\)00009-0](https://doi.org/10.1016/S0094-730X(97)00009-0)

Yaruss, J. S., & Quesal, R. W. (2006). Overall Assessment of the Speaker's Experience of Stuttering (OASES): Documenting multiple outcomes in stuttering treatment. *Journal of fluency disorders*, 31(2), 90-115.

APPENDIX: IRB CERTIFICATION



March 20, 2019

Kayla Sherbert  
Department of Communicative Disorders  
College of Arts and Sciences  
Box 870242

Re: IRB # 19-OR-084-ME, "Factors that Influence the Variability of Stuttering"

Dear Ms. Sherbert:

The University of Alabama Institutional Review Board has granted approval for your proposed research. Your application has been given expedited approval according to 45 CFR part 46. Approval has been given under expedited review category 7 as outlined below:

*(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.*

The approval for your application will lapse on March 18, 2020. If your research will continue beyond this date, please submit the continuing review to the IRB as required by University policy before the lapse. Please note, any modifications made in research design, methodology, or procedures must be submitted to and approved by the IRB before implementation. Please submit a final report form when the study is complete.

Please use reproductions of the IRB approved informed consent form and recruitment flyer.

Good luck with your research.

Sincerely,



Carpantato T. Myles, MSM, CJM, CIP  
Director & Research Compliance Officer

September 11, 2019

Kayla Sherbert  
Department of Communicative Disorders  
College of Arts & Sciences  
The University of Alabama  
Box 870242

Re: IRB # 19-OR-084-ME-D "Factors that Influence the Variability of Stuttering"

Dear Ms. Sherbert:

The University of Alabama Institutional Review Board has reviewed the revision to your previously approved expedited protocol. The board has approved the change in your protocol.

Please remember that your protocol will expire on March 18, 2020.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants.

Good luck with your research.

Sincerely,



Carpantato T. Myles, MSM, CIM, CIP  
Director & Research Compliance Officer

February 24, 2020

Kayla Sherbert  
Department of Communicative Disorders  
College of Arts & Sciences  
The University of Alabama  
Box 870242

Re: IRB # 19-OR-084-ME-R1 "Factors that Influence the Variability of Stuttering"

Dear Ms. Sherbert:

The University of Alabama Institutional Review Board has granted approval for your renewal application. Your renewal application has been given expedited approval according to 45 CFR part 46. Approval has been given under expedited review category 7 as outlined below:

*(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.*

The approval for your application will lapse on February 23, 2021. If your research will continue beyond this date, please submit a continuing review to the IRB as required by University policy before the lapse. Please note, any modifications made in research design, methodology, or procedures must be submitted to and approved by the IRB before implementation. Please submit a final report form when the study is complete.

Please use reproductions of the IRB approved informed consent form to obtain consent from your participants.

Good luck with your research.

Sincerely,

  
Carpantato T. Myles, MSM, CIM, CIP  
Director & Research Compliance Officer