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# An exploratory factor analysis of action responses to stuttering anticipation

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ABSTRACT

*Purpose:* We previously introduced the*Stuttering Anticipation Scale* (SAS; Jackson, E. S., Gerlach, H., Rodgers, N. H., & Zebrowski, P. M. (2018). My Client Knows That He's About to Stutter: How Can We Address Stuttering Anticipation during Therapy with Young People Who Stutter? *Seminars in Speech and Language*, *39*, 356–370) – a non-standardized self-report measure for children, teens, and adults who stutter (CWS, TWS, AWS) that quantifies how often they engage in 25 commonly reported action responses to anticipation. The purpose of this study was to leverage the SAS to explore the factor structure of action responses to stuttering anticipation.
*Methods:* A total of 121 people who stutter completed the SAS online (27 CWS, 40 TWS, 54 AWS). We used exploratory factor analysis (EFA) to determine the underlying latent variables within the 25 SAS items that characterize how people who stutter respond to anticipation.
*Results:* A three-factor model was most appropriate for the data with regard to factor loadings and other model fit indices. The three factors were named: avoidance (17 items), physical change (4 items), and approach (4 items).
*Conclusion:* Understanding these three types of action responses to anticipation can help guide clinical decision-making by providing a novel framework for clinicians and their clients who stutter to discuss how the client tends to respond to anticipation, and explore ways to facilitate productive responses to anticipation.

## 1. Introduction

Interest in stuttering anticipation has been revitalized in recent years due to its pervasiveness in the stuttering experience, as well as the key role that it plays in the manifestation of overt stuttering events and social-cognitive and affective reactions to stuttering (Arenas & Zebrowski, 2013, 2017; Bowers, Saltuklaroglu, & Kalinowski, 2012; Briley, 2017; Cholin, Heiler, Whillier, & Sommer, 2016; Garcia-Barrera & Davidow, 2015; Jackson, Gerlach, Rodgers, & Zebrowski, 2018; Jackson, Yaruss, Quesal, Terranova, & Whalen, 2015; Mersov, Cheyne, Jobst, & De Nil, 2017). Anticipation refers to the speaker's awareness that upcoming speech will be stuttered, should that speech be executed as planned. Anticipation is rooted in prior social experiences and associative learning (Bloodstein, 1972; Garcia-Barrera & Davidow, 2015; Johnson & Knott, 1936). For example, a speaker may stutter in a particular social context, receive negative listener feedback, and subsequently develop associations between stuttering events and negative listener reactions in that context. As a result of this learned association, the speaker may become more attuned to interruptions in

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speech-language planning, and thus, more likely to anticipate overt stuttering. Overt stuttering events are not always preceded by anticipation because sometimes, attention is not directed towards speech-language planning (e.g., when stuttering happens too quickly for the speaker to become aware of anticipation prior to execution). Similarly, anticipation is not always followed by overt stuttering events, for example, when the speaker alters the speech production process to disguise or conceal stuttering (e.g., by stalling or switching words).

Stuttering anticipation is prevalent among people who stutter across the lifespan, although AWS tend to anticipate to a greater degree than CWS (2015, Jackson et al., 2018; Knott, Johnson, & Webster, 1937; Silverman & Williams, 1972; Van Riper, 1936). Recent studies on anticipation have implemented variations of a feared/non-feared words paradigm to assess the physiological correlates of anticipation. Bowers et al. (2012) created individualized word lists based on sounds that participants reported would likely elicit stuttering. They found that feared words, but not stuttered words, were associated with increased autonomic arousal. Using a similar anticipation rating scheme, Arenas and Zebrowski (2017) reported a positive relationship between anticipation and verbal response time for fluent utterances among their participants who stuttered the most severely. Other research groups are developing ways to quantify the extent of anticipation in people who stutter. For example, Cholin et al. (2016) created the Premonitory Awareness in Stuttering Scale (PAiS), a 12-item questionnaire that assesses immediate and prospective anticipation. The PAiS is based on recent work on tic disorders. Cholin et al. argue that premonitory urges in tic disorders are similar to stuttering anticipation.

Understanding not just the extent but also the nature of anticipation has immense clinical utility. While it is helpful for clinicians to know how often their client anticipates stuttering, it is also clinically meaningful to know how people who stutter *respond* to anticipation. In other words, what does a particular speaker do when she senses that a moment of overt stuttering is forthcoming? While people who stutter may not be able to directly prevent a stuttering event, they can often choose how they move forward after anticipating stuttering. In this way, understanding what a speaker does in response to anticipation can drive clinical decision-making and ultimately improve clinical outcomes.

To help clinicians better understand how their clients who stutter respond to anticipation, we previously created the *Stuttering Anticipation Scale* (SAS; Jackson et al., 2018), a non-standardized clinical self-report tool that allows clients who stutter to identify how often they respond to anticipation in specific ways. The SAS is based on our previous qualitative work that identified how AWS respond to anticipation, focusing on *action* response types (Jackson et al., 2015). Action responses included those associated with a decision to alter an aspect of the speaker's verbal or nonverbal communication (e.g., switch a word, stall, use a speaking strategy, maintain eye contact, take a breath). We asked 30 AWS to describe what they do when they anticipate stuttering. Based on their responses, we created the SAS using the 25 most common action responses to stuttering anticipation. While the SAS is based on responses from AWS, we informally assessed its feasibility for younger speakers. First, we field tested it with ten 9–12 year-old CWS and found that they were able to describe the various ways in which they responded to anticipation, including many of those included in the SAS (Jackson et al., 2018). Then, we administered the SAS to 23 CWS and 27 TWS (data from these participants were included in the current study) and found that each SAS item was experienced by at least one-third of the CWS and TWS (Jackson et al., 2018). We took these findings as preliminary evidence that the SAS is appropriate to use with CWS and TWS to informally assess the extent to which they engage in 25 commonly reported responses to anticipation. Currently, the SAS does not provide an overall score or subscale scores for different response classes.

The purpose of the present study was to deepen our understanding of the patterns of action responses to the anticipation of stuttering in CWS, TWS, and AWS. To do so, we conducted an exploratory factor analysis (EFA) on responses from the SAS from 121 people who stutter ranging in age from nine to 63. EFA is a data reduction approach for determining whether a large set of variables can be represented by a smaller set of latent variables or factors (Fabrigar & Wegener, 2011). Thus, we were interested in leveraging the SAS to examine the structure of responses to anticipation. Although our present goal was not to validate the SAS itself, the information gathered from this study will increase the clinical utility of the SAS by granting clinicians and clients insight into a client's specific patterns of responding to anticipation and thus drive clinical decision-making. A primary goal of stuttering therapy is to facilitate productive responses and minimize unproductive responses to stuttering anticipation, as determined by the client. A greater understanding of the nature of responses to stuttering anticipation could facilitate 1) targeting of therapy goals with increased specificity, and 2) examination of the relationship between responses to anticipation and contributing factors (e.g., temperament or linguistic factors). It should be noted that when used clinically, the SAS as a non-standardized questionnaire can be modified as needed to flexibly meet the needs of individual clients. However, for research purposes, as in the present study, the SAS should be used as it is provided for consistency and reproducibility across studies.

## 2. Methods

### 2.1. Participants

This study was approved by the Institutional Review Boards at the authors' institutions. Participants included 27 CWS (5 female/22 male; aged 9–12, M = 11.04, SD = 1.06), 40 TWS (13 female/27 male; aged 13–17, M = 14.70, SD = 1.31), and 54 AWS (18 female/36 male; aged 18–63, M = 30.74, SD = 10.05), who were recruited through local clinics, mass emails to national support organizations for people who stutter, and referrals from stuttering specialists across the country. Many of these participants (23 CWS and 27 TWS) also provided the extent data reported in Jackson et al. (2018). Parents of CWS and TWS confirmed that their child stuttered and provided consent for their child's participation before the child assented and completed the SAS. The AWS confirmed that their stuttering was developmental before providing consent and completing the SAS.

### 2.2. Measure

The SAS was administered electronically using Qualtrics. Participants were first provided with a definition of anticipation:

*Many people who stutter know that they are going to stutter before they actually do. This is called anticipating stuttering. For example, if you are about to say your name or phone number or favorite food and know that you will stutter when saying it, you are anticipating stuttering.*

This definition was followed by the question, "How much do you anticipate stuttering?" Participants were asked to respond to the question by dragging a cursor along a visual analogue scale that included "Never" (leftmost anchor of the scale), "Rarely," "Sometimes," "Often," and "Always" (rightmost anchor of the scale). Data from this question were previously reported in Jackson et al. (2018). Participants were then presented with 25 questions that each asked about a specific response to anticipation such as, "How often do you switch words that you think you will stutter on?" and "How often do you stall or pause when you think you are about to stutter?" (see Table 1 for a complete list of the SAS items). Participants responded to each of the 25 questions by dragging a cursor along the visual analog scale. The labels of the scale included "Never" (leftmost anchor), "Rarely," "Sometimes," "Often," "Always" (rightmost anchor). The scale yielded values between .01 and 100, though these values were not visible to the participants. A similar approach was used by Arenas and Zebrowski (2017) to collect subjective ratings of anticipation. Regarding our decision to collect continuous data, the informal nature of the SAS allows researchers and SLPs flexibility in determining whether to implement the SAS as a visual analog or Likert scale. A visual analog scale may be appropriate for researchers if the research questions are associated with continuous data, or if there is interest in obtaining more variance in the data (as in the current study). A Likert scale may be appropriate for SLPs interested in administering the SAS by hand (i.e., not electronically). Ultimately, this decision should be left to the researcher or SLP.

### 2.3. Data analysis

#### 2.3.1. Checking assumptions

The data were analyzed using the *psych* package (Revelle, 2017) in R (R Core Team, 2017). All data were continuous. Prior to conducting the EFA, we evaluated the data on the following statistical assumptions: normality, linearity, and factorability. The data were not normally distributed, but there is evidence that EFA is robust to violations of this assumption (Curran, West, & Finch, 1996; Fabrigar & Wegener, 2011). Similarly, the data did not yield perfect linear relationships; however, there was evidence of linearity across SAS items. To examine the factorability, we calculated correlations across all SAS items. Correlations ranged from -0.30 to 0.74, and the majority of correlations were greater than 0.40. Therefore, the data were sufficiently related for factorability, and the data, overall, adequately met the assumptions for the exploratory nature of the analyses.

#### 2.3.2. Scree plot and parallel analysis

We estimated the number of possible factors in two ways. First, we visually examined the scree plot (see Fig. 1), which is the most common method (Cattell & Jaspers, 1967; Cattell, 1966). Researchers look for two elements: a significant drop in eigenvalues and the point at which the raw data path drops below the simulated data path. To bolster the visual analysis, we conducted a parallel analysis, which compared the eigenvalues from the actual data to expected eigenvalues from random data. (Fabrigar & Wegener, 2011).

#### 2.3.3. Exploratory Factor Analysis (EFA)

We used Ordinary Least Squares factoring (*minres* package in R) for all models because it yields results similar to commonly used maximum likelihood estimation without assuming multivariate normality. In addition, we used the oblique rotation method. SAS questions measure some aspect of responding to anticipation, so we expected the latent factors to correlate to some degree. The oblique rotation method allows the factors to correlate (Hendrickson & White, 1964).

We compared each model based on four criteria: factor loadings, the root mean square of residuals (RMSR), the root mean square error of approximation (RMSEA), and the Tucker-Lewis Index (TLI). Consistent with previous research, we considered an item-factor loading of 0.30 or greater to be adequate (Tabachnick & Fidell, 2007). In addition, we considered instances in which items yielded loadings greater than 0.30 on more than one latent factor as evidence of poor model fit. The RMSR and RMSEA are measures of error, and values below 0.05 are desirable for both indices (Brown, 2014). The TLI is a measure of the proposed model against a null model, and 0.90 is often considered minimally acceptable (Bollen, 1989; Hu & Bentler, 1999).

## 3. Results

### 3.1. SAS responses

Table 1 provides relevant data for each SAS item including factor loadings and descriptive data for each age group and the sample as a whole. Inspection of the descriptive data revealed that there may be group differences with respect to some of the items (e.g., 1, 12), although there was substantial variation within each group for each response. This is to be expected as individual participants will have their own unique way of responding to anticipation; while the SAS represents common responses to anticipation, each speaker will have their own constellation of behaviors that is not necessarily comprised of the same responses to anticipation. Still, there seem to be consistent age-related patterns across several of the SAS average item scores. For example, for item 1, CWS = 35.5,

**Table 1**
Factor loadings and descriptive data for each item on the Stuttering Anticipation Scale (SAS; Jackson et al., 2018), including the 25 questions from the SAS (with permission). The three *Factor Loadings* columns contain factor loadings for each SAS item with loadings of 0.30 or greater indicated in bold. Following convention, loadings of 0.30 or greater are deemed adequate, and are thus bolded in the table. The *CWS*, *TWS*, and *AWS* columns provide means and standard deviations (in parentheses) for each SAS item by age group. The *total* column provide means and standard deviations (in parentheses) for the entire study sample.

| | | FACTOR LOADINGS | | | DESCRIPTIVE DATA | | | |
|---|---|---|---|---|---|---|---|---|
| | SAS Item | Factor 1: Avoidance | Factor 2: Physical Change | Factor 3: Approach | CWS n = 27 | TWS n = 40 | AWS n = 54 | Total n = 121 |
| 1 | How often do you try to say things in a different way (i.e., change words around) when you think you are going to stutter? | **0.7** | 0.06 | −0.22 | 35.49 (27.11) | 41.41 (29.88) | 54.78 (26.77) | 45.72 (29.11) |
| 2 | How often do you slow your speech when you think you are about to stutter? | 0.03 | **0.62** | −0.03 | 44.76 (28.54) | 44.82 (28.73) | 45.04 (23.12) | 44.90 (26.45) |
| 3 | How often do you switch a word that you think you will stutter on with a word that you think you won't stutter on? | **0.62** | 0.22 | −0.26 | 35.05 (22.08) | 45.46 (27.75) | 52.16 (28.84) | 45.91 (27.84) |
| 4 | How often do you speak faster when you think you are about to stutter? | **0.55** | −0.06 | −0.04 | 25.52 (28.42) | 33.38 (25.88) | 39.35 (28.96) | 34.11 (28.31) |
| 5 | How often do you move other parts of your body (e.g., your head, arms) when you think you are about to stutter? | **0.34** | 0.25 | −0.05 | 44.56 (35.1) | 43.40 (31.40) | 42.84 (30.01) | 43.43 (31.72) |
| 6 | How often do you take a breath in or out when you think you are about to stutter? | 0.19 | **0.59** | 0.05 | 43.99 (29.28) | 50.66 (30.81) | 39.91 (27.21) | 44.58 (29.36) |
| 7 | How often do you swallow when you think you are about to stutter? | **0.37** | 0.11 | 0.05 | 20.15 (27.27) | 17.90 (22.32) | 21.44 (25.61) | 19.92 (24.97) |
| 8 | How often do you try to "relax" when you think you are about to stutter? | 0.14 | **0.49** | 0.19 | 51.12 (34.24) | 50.92 (32.86) | 55.68 (29.04) | 52.98 (31.72) |
| 9 | How often do you stall or pause when you think you are about to stutter? | **0.45** | **0.32** | −0.21 | 43.37 (30.37) | 47.83 (27.31) | 53.08 (27.87) | 49.03 (28.53) |
| 10 | How often do you change what you are talking about (i.e., change topics) when you think you are about to stutter? | **0.62** | 0.08 | 0 | 19.09 (30.22) | 20.00 (25.84) | 31.53 (28.59) | 24.68 (28.67) |
| 11 | How often do you try to use a speaking strategy or speech tool when you think you are about to stutter? | −0.06 | **0.46** | 0.24 | 58.25 (29.18) | 50.81 (30.76) | 45.62 (26.65) | 50.31 (29.13) |
| 12 | How often do you avoid speaking completely when you think you are about to stutter? | **0.76** | −0.03 | −0.04 | 14.98 (24.27) | 26.39 (26.42) | 41.98 (29.93) | 30.39 (29.56) |
| 13 | How often do you change the volume of your voice (i.e., get louder or softer) when you think you are going to stutter? | **0.4** | **0.34** | −0.05 | 23.5 (27.16) | 30.17 (26.45) | 30.46 (30.42) | 28.76 (28.50) |
| 14 | How often do you use words like "um" or "uh" or "like" when you think you are about to stutter? | **0.44** | 0.22 | −0.09 | 62.49 (33.88) | 60.84 (30.35) | 58.92 (30.48) | 60.4 (31.28) |
| 15 | How often do you try to fake stutter when you think you are going to stutter? | 0.29 | −0.29 | **0.44** | 8.23 (19.77) | 9.08 (15.23) | 18.56 (23.12) | 12.90 (20.50) |
| 16 | How often do you tell the person you're talking to that you stutter when you think you are about to stutter? | 0.23 | −0.11 | **0.43** | 11.81 (19.03) | 19.76 (24.91) | 21.93 (23.30) | 18.86 (23.33) |
| 17 | How often do you look away from the person you're talking to when you think you are about to stutter? | **0.53** | −0.02 | **−0.33** | 31.22 (31.24) | 47.19 (31.42) | 54.31 (29.25) | 46.55 (31.76) |
| 18 | How often do you think, "I'm just gonna stutter" when you think you are about to stutter anyway? | −0.13 | 0.16 | **0.45** | 59.02 (32.91) | 60.97 (27.05) | 43.91 (31.32) | 53.29 (31.36) |
| 19 | How often do you look right at the person you are talking to when you think you are about to stutter? | −0.15 | 0.16 | **0.66** | 50.87 (32.45) | 45.61 (33.02) | 40.62 (30.59) | 44.7 (32.13) |
| 20 | How often do you interrupt the person you are talking to when you think you are about to stutter (i.e. talk before it's your turn)? | **0.58** | −0.27 | 0.11 | 14.11 (20.02) | 12.83 (19.49) | 24.72 (27.98) | 18.16 (24.23) |
| 21 | How often do you let someone else speak for you when you think you are about to stutter? | **0.64** | −0.15 | −0.13 | 23.21 (28.34) | 27.21 (24.47) | 29.77 (28.33) | 27.38 (27.17) |
| 22 | How often do you push or force the word out when you think you will stutter on it? | **0.43** | −0.03 | 0 | 43.76 (27.63) | 46.19 (29.99) | 48.21 (24.53) | 46.49 (27.30) |
| 23 | How often do you keep quiet when you think you will stutter? | **0.66** | −0.07 | −0.15 | 27.88 (30.23) | 44.45 (32.08) | 46.74 (29.66) | 41.63 (31.57) |
| 24 | How often do you text or instant message instead of talking, when you think you will stutter? | **0.68** | −0.15 | −0.04 | 26.42 (37.4) | 33.69 (34.47) | 42.55 (34.36) | 35.78 (35.70) |
| 25 | How often do you try to distract yourself (e.g., pretend to do something else) when you think you are about to stutter? | **0.8** | −0.18 | 0.17 | 14.72 (25.69) | 24.90 (25.30) | 36.27 (32.10) | 27.39 (29.70) |

TWS = 41.4, and AWS = 54.8; for item 19, CWS = 50.9, TWS = 45.6, and AWS = 40.6. While not the purpose of this study, future studies should examine these trends. A Cronbach's standard alpha value of .85 indicated satisfactory internal consistency of the SAS.

### *3.2. Factor analysis*

#### *3.2.1. Scree plot and parallel analysis*

Visual inspection of the scree plot and parallel analysis in Fig. 1 suggested that two to four factors were possible given our data.

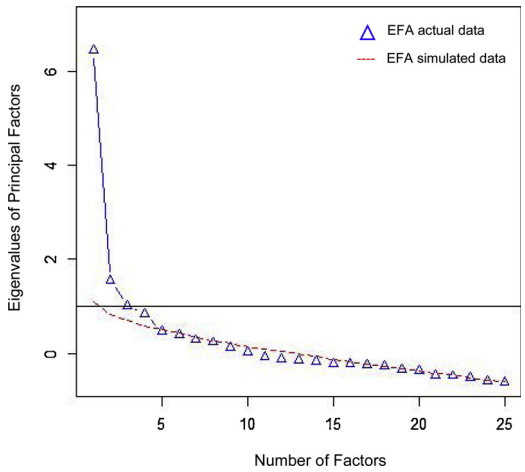


**Fig. 1.** Scree plot depicting the parallel analysis used to determine the number of meaningful factors.

The integral aspect of Fig. 1 is the convergence between the actual data path and simulated data path. As the intersection of these two data paths occurs at five factors, the models can thus accommodate up to four factors. The results of the parallel analysis suggested a four-factor model. Therefore, we compared two-, three-, and four-factor models.

### *3.2.2. EFA model comparisons*

Model fit indices for the two-, three-, and four-factor models are included in Table 2. The three- and four-factor models yielded slightly better RMSR statistics than the two-factor model (.07, .07, .08, respectively). The four-factor model yielded a marginally superior RMSEA statistic than the two- and three- factor models (.07, .09, .09, respectively). The three- and four-factor models yielded marginally better TLI statistics than the two-factor model (.77, .77, .72, respectively). However, these model fit indices are best considered holistically along with the factor loadings to determine which model best fits the data.

We next looked for discrepancies in the factor loadings, such as double loadings, low loadings, and negative loadings. Overall, the two- and three-factor models provided similar results. There were several instances of double loadings when individual SAS items met the .30 cutoff for loading on multiple factors. In the two-factor model, item 19 exhibited a double loading on both factors. In the three-factor model, items 9, 13, and 17 yielded double loadings on two factors. In the four-factor model, items 9, 13, 16, and 20 exhibited double loading on two factors. Instances of items loading onto multiple factors makes it difficult to determine the factor in which these particular items belong. Gorsuch (1983) suggests choosing one factor over another if one loading is meaningfully greater than the other. A loading difference of .2 (in absolute terms) meets this criterion. Related to low loadings, the two- and four-factor models contained several items that did not reach the .30 cutoff (items 15, 16 in the two-factor model; item 7 in the four-factor model). Additionally, negative loadings suggest that those items are inversely related to the other items that load onto that factor and can be difficult to interpret. The two- and three-factor models each yielded one item with a negative loading (items 19 and 17, respectively), although both of these negative loadings accompanied a double loading where the other item had a positive loading greater than the .30 cutoff. The four-factor model yielded one item with a negative loading (item 17) that loaded on a single factor.

In considering the model fit indices and factor loadings together, we selected the three-factor model as the best fit for these data. Factors 1, 2, and 3 accounted for 27%, 8%, and 6% of the variance in the model, respectively.

### *3.2.3. Factor labels*

Factors were labeled by the first and second authors, who have specialized experience in stuttering therapy with CWS, TWS, and AWS. Factor labels were first assigned by the authors independently, and discrepancies were then discussed. There was clear agreement between the authors for the first and third factor labels. The second label was more ambiguous (see below). Factor loadings are visually presented in Fig. 2.

Factor 1 was comprised of the majority of SAS items (17/25) including questions 1, 3–5, 7, 9–10, 12–14, 17, 20-25. These questions focus on attempts to *not* stutter. As a result, factor 1 was labeled **avoidance**. Factor 1 included items such as:

**Table 2**
Model fit indices. RMSR = root mean square of residuals; RMSEA = root mean square of approximation; TLI = Tucker-Lewis Index.

| | Two-Factor Model | Three-Factor Model | Four-Factor Model |
|---|---|---|---|
| RMSR | .08 | .07 | .07 |
| RMSEA | .09 | .09 | .07 |
| TLI | .72 | .77 | .77 |

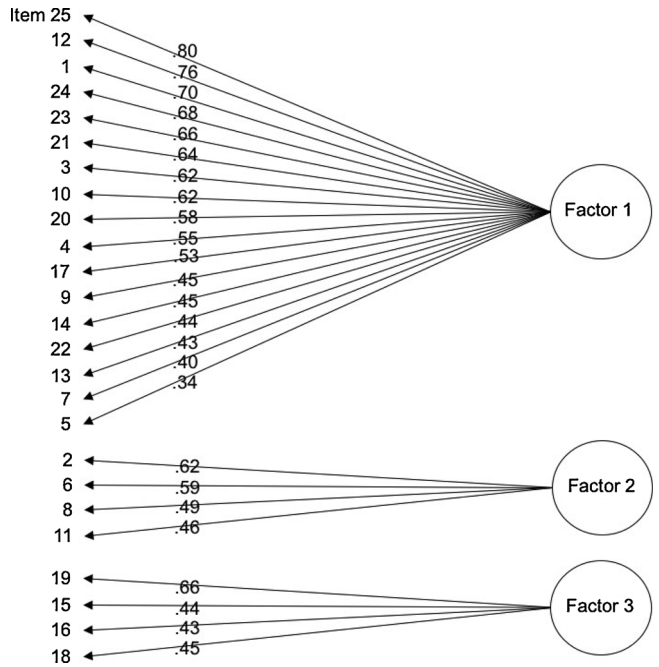


**Fig. 2.** Visual representation of factor loadings for the three-factor model. SAS questions are included in Table 1.

- "How often do you try to say things in a different way (i.e., change words around) when you think you are going to stutter?" (item 1)
- "How often do you switch a word that you think you will stutter on with a word that you think you won't stutter on?" (3)
- "How often do you stall or pause when you think you are about to stutter?" (9)
- "How often do you avoid speaking completely when you think you are about to stutter?" (12)
- "How often do you let someone else speak for you when you think you are about to stutter?" (21)

Factor 2 included four SAS items (2, 6, 8, and 11). Factor 2 was less straightforward than factors 1 and 3, as it encompassed items related to "traditional" speaking modification strategies and functional speech change, yet these items are also related to the act of centering (e.g., taking a breath, slowing down, trying to relax) which is neither avoiding nor approaching overt stuttering. Critically, these items all relate to physical change, particularly that of the speech mechanism. Because of this, factor 2 was labeled **physical change**. The following items comprised factor 2:

- "How often do you slow your speech when you think you are about to stutter?" (item 2)
- "How often do you take a breath in or out when you think you are about to stutter?" (6)
- "How often do you try to "relax" when you think you are about to stutter?" (8)
- "How often do you try to use a speaking strategy or speech tool when you think you are about to stutter?" (11)

Factor 3 included four SAS items (15, 16, 18, and 19). These questions are related to the speaker's decision to stutter overtly without avoiding. Thus, factor 3 was labeled **approach**. The following items comprised factor 3:

- "How often do you try to fake stutter when you think you are going to stutter?" (item 15)
- "How often do you tell the person you're talking to that you stutter when you think you are about to stutter?" (item 16)
- "How often do you think, "I'm just gonna stutter" when you think you are about to stutter anyway?" (item 18)
- "How often do you look right at the person you are talking to when you think you are about to stutter?" (item 19)

## 4. Discussion

This study examined the underlying structure of responses to stuttering anticipation by leveraging the SAS, a non-standardized clinical tool that assesses the extent to which individuals who stutter engage in 25 commonly reported action responses to anticipation. To this end, we conducted an EFA with two-, three-, and four-factor models. Our analysis revealed that a three-factor model including avoidance, physical change, and approach fit the data best. Thus, the SAS suggests that people who stutter respond to anticipation by avoiding overt stuttering, focusing on the body to change speech (not avoiding or approaching), and approaching or confronting overt stuttering.

### 4.1. The three factors

The avoidance factor (factor 1) comprised 17 of 25 SAS items, and accounted for nearly twice the variance of the other two factors combined, indicating that the SAS primarily measures avoidance responses. It is widely known that people who stutter avoid or attempt to avoid overt stuttering. The current results highlight that avoidance is a response to anticipation (e.g., when a person thinks or knows that he is about to stutter), which is more specific than claims that avoidance results from overt stuttering. This distinction is not trivial, as it reinforces that the behavioral responses associated with avoidance occur prior to the overt stuttering event. That is, once the speaker becomes aware that continuing speech production will likely result in overt stuttering (i.e., once he anticipates), he has a choice: he can temporarily or altogether avoid that particular overt stuttering event, or decide to do something to facilitate "moving through" it. Whereas the latter is the primary objective of many stuttering therapies, the former (i.e., avoidance), which has also been referred to as safety behavior, may result in immediate reductions in anxiety but ultimately perpetuate the problem by preventing disconfirmation of negative thoughts or fears (Helbig-Lang & Petermann, 2010; Lowe et al., 2017). For example, avoiding a moment of overt stuttering may relieve the speaker of stress in that situation but may also increase stress the next time that the speaker is in a similar speaking situation. Safety behaviors are thought to contribute to social anxiety disorder (SAD; Rapee & Heimberg, 1997), which has critical implications for people who stutter. Studies of social anxiety among people who stutter has indicated that rates of social anxiety generally tend to be higher in CWS (Iverach et al., 2016), TWS (Gunn et al., 2014), and AWS (Blumgart, Tran, & Craig, 2010; Iverach et al., 2009) than in typically-developing peers. SAD negatively impacts quality of life (Slade, Teesson, & Burgess, 2009), and therefore understanding how speakers respond to anticipation will benefit therapies that are concerned with improving quality of life, or reducing the potential for negative impact on quality of life, in speakers who stutter. For this discussion, it is important to highlight that we are focusing on specific avoidance related to a particular stuttering event in time, and not longer-term or non-specific avoidance related to a looming sense of stuttering at some time in the future.

The physical change factor (factor 2) represents items that included a decision to alter oneself physically (i.e., reduce speech rate, take a breath, use a speech tool). The speaker has made a decision to involve her body and this change is closely related to proprioception or the speaker's ability to sense her body parts, particularly those that comprise the speech mechanism. Indeed, AWS are known to exhibit sensorimotor integration difficulties (Sommer, Koch, Paulus, Weiller, & Büchel, 2002; Cai et al., 2012; Loucks & De Nil, 2006; Max, 2004). Physical change in response to anticipation appears to represent the speaker's attempt to reclaim control, after she has lost speech motor control and prior to overt stuttering. This type of response to anticipation potentially reflects the speaker's attempt to regain control by being present (e.g., slowing down, breathing, "relaxing"). This may be why an increasing body of work is pointing to mindfulness-based practices as beneficial to AWS (Boyle, 2011; Cheasman et al., 2013; Gupta, Yashodharakumar, & Vasudha, 2016; Plexico & Sandage, 2011). However, the responses that fall under the physical change factor also coincide with unproductive feedback that CWS might receive from parents and teachers (e.g., "Slow down", "Remember to breathe"). The four SAS items included in this factor may reflect an underlying variable related to speaking strategies that may be helpful, but by themselves do not address the whole of the problem (e.g., cognitive and affective aspects of stuttering). Further investigation is required to tease apart the different aspects of physical change. However, using speech tools, trying to be present in a moment of stuttering, and unhelpful advice (e.g., "Slow down," "Breathe") from those in one's environment, all clearly relate to some aspect of physical change, which validates the existence of this factor.

The approach factor (factor 3) represents responses for which the speaker decided to confront overt stuttering. The current study revealed that approach tactics such as self-disclosure and pseudostuttering during which the speaker tells his communicative partners that he stutters or feigns stuttering, respectively, are also included in this factor. These approach strategies are contrasted with traditional speech management strategies for which the goal is to mitigate overt stuttering. Self-disclosure has been reported as a beneficial approach-oriented strategy for many people who stutter as it diminishes the pressure they feel to be fluent, reduces their fear of the listener finding out that they stutter, minimizes the stigma listeners might attribute to a person who stutters, and may even facilitate positive listener affect as the element of surprise for the listener is removed (L. Plexico, Manning, & DiLollo, 2005; L. Plexico, Manning, & Levitt, 2009). Further, self-disclosures that are performed in an informative manner tend to have more positive effects on listeners as opposed to not disclosing at all or disclosing in an apologetic manner (Byrd, Croft, Gkalitsiou, & Hampton, 2017). Overall, approach behaviors such as self-disclosure, pseudostuttering, stuttering openly, and maintaining eye contact may reflect a speaker's sense of agency – that she has the capacity for self-directed thoughts and behaviors when choosing how to respond to stuttering anticipation. Emerging work in the area of self-efficacy among adults who stutter has reported that self-efficacy is related to overall quality of life and communicative participation (2018, Boyle, 2015; Boyle, Beita-Ell, Milewski, & Fearon, 2018).

### 4.2. Implications

How one responds to stuttering anticipation should be a focus in therapy. The uncertainty related to managing imminent speech interruptions and listener reactions can be overwhelming (e.g., "What will she think when she hears me stutter?", "When is the right time to reveal my stuttering?"). An increased understanding of anticipation and how one responds to it will better prepare individuals who stutter to make a priori changes to physical aspects of speech after anticipating stuttering. This thinking is in line with the Iowa approach to stuttering therapy (e.g., Quesal & Yaruss, 2000; Williams, 1957; Zebrowski & Arenas, 2011), which focuses on reducing behaviors, thoughts, and beliefs that interfere with forward-moving speech, and increasing attention to behaviors, thoughts, and beliefs that facilitate forward-moving speech. Incorporating use of the SAS and the factor labels derived in this study with clients who stutter can facilitate discussion about their anticipation and productive ways to respond to it. For example, many individuals who stutter identify that avoiding overt stuttering contributes to negative feelings including shame, embarrassment, and guilt (Sheehan,

1975). Indeed, avoidance, or safety behaviors, has been shown to contribute to the maintenance of anxiety generally (Helbig-Lang & Petermann, 2010)(Helbig-Lang & Petermann, 2010) and social anxiety in AWS (Lowe et al., 2017). Therapy for these individuals could involve first identifying anticipation and avoidance responses, and progress towards approach responses (e.g., openly stuttering, pseudostuttering, disclosing), which may ultimately facilitate physical changes that allow the speaker to move through stuttering events in easier ways.

### 4.3. Limitations

These results should be interpreted with caution, as there are several important limitations associated with the study. The sample size was modest and the analysis was likely underpowered. Unlike some research designs, determining adequate sample size for factor analyses is not straightforward. Some researchers have argued that 100 (e.g., Gorsuch, 1983; Kline, 2014) or 200 participants (e.g., Comrey, Lee, & Lee, 2013) is acceptable. However, other researchers have argued that power is best evaluated through a ratio of participants to observed measures. For example, Cattell (1978) suggested that a ratio of three to six participants per item is sufficient, whereas Everitt (1975) argued for at least 10 participants per measure. Future investigations would benefit from a sample of at least 150 to 250 participants to ensure adequate power (i.e., six to 10 participants for each of the 25 SAS items). Second, responses on the SAS may have been impacted by age. For certain SAS items, the AWS appeared to exhibit greater scores than the TWS, who appeared to exhibit greater scores than the CWS. This likely weakened the factor loadings such that a sample with a more restrictive age range may have increased the loadings ratios and better differentiated the three factors. However, we view the large age range as a strength of the study as it allows for generalization of the results across these ages. Future studies could more rigorously investigate the impact of age on how people who stutter respond to anticipation. Third, the visual analog scale may have introduced random error, for example, it is possible that small score differences (e.g., 35.7 versus 37.9) may not reflect meaningful differences. Further, the visual analog scale may have contributed to the lack of a perfectly linear relationship between SAS items. A future version of the SAS that uses Likert-style items may reduce variability in participant responses and increase the variance explained, which in the current study was 41%. Finally, the results of this analysis do not suggest that the three-factor model is a perfect fit for the data. The TLI for the model was below the desired 0.90 cutoff, though the RMSR and RMSEA values approached the desired 0.05 criterion.

### 4.4. Future directions

A confirmatory factor analysis (CFA) with sufficient power could be carried out to confirm the three-factor model presented here. It may also be revealing to include additional action responses to anticipation in an expanded version of the SAS so that the factors may be more robust, particularly for the physical change (factor 2) and approach (factor 3) factors as these each only contained four items. Additionally, examining constitutional and experiential variables that predict responses to anticipation could augment our understanding of the characteristics that drive avoidance, physical change, and approach. To address one aspect of this relationship, our group is currently examining the impact of various temperament constructs on how individuals respond to anticipation. This would provide practical clinical utility as it may facilitate prediction of stuttering chronicity or those who may experience a more significant negative impact due to stuttering.

## 5. Conclusion

We conducted an exploratory factor analysis to determine the underlying structure of responses to stuttering anticipation in CWS, TWS, and AWS with respect to the SAS. Results revealed three factors – avoidance, physical change, and approach – indicating that the SAS may be sensitive to identifying three common ways that people who stutter respond to the anticipation of stuttering. Taking inventory of these action responses can guide clinical decision-making related to how individuals who stutter can productively respond to anticipation. In addition, these factors can drive empirical investigations that seek to determine the impact of various characteristics (e.g., temperament, language) on one's ability to respond to stuttering anticipation.

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## Appendix A

*CEU questions*

Exploratory factor analysis is:

1 a descriptive analysis of latent variables such as anticipation
2 a data-reduction approach used to find latent or hidden variables in a dataset
3 an exploration of cognitive phenomena such as anticipation
4 an exploratory analysis of complex phenomena associated specifically with stuttering

The questions from the *Stuttering Anticipation Scale* (SAS) likely represent an underlying structure that includes all of the following types of action responses to stuttering anticipation except for:

1 embodied change
2 anxiety
3 approach
4 avoidance

Which of the following questions is not included in the avoidance factor?

1 How often do you try to say things in a different way (i.e., change words around) when you think you are going to stutter?
2 How often do you look away from the person you're talking to when you think you are about to stutter?
3 How often do you try to use a speaking strategy or speech tool when you think you are about to stutter?
4 How often do you keep quiet when you think you will stutter?
5 All of these are included in the avoidance factor

Which models yielded similar factor loadings among the 25 SAS items?

1 The two- and three-factor models
2 The two- and four-factor models
3 The three- and four-factor models
4 All the models yielded very different factor loadings
5 All the models yielded very similar factor loadings

In this paper, anticipation is conceptualized as…

1 a looming sense that one will stutter in a future encounter
2 fear that listeners will react negatively to one's stuttering
3 awareness that upcoming speech will be stuttered, should speech be executed as planned
4 All of the above

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