



Premonitory Awareness in Stuttering Scale (PAiS)



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ABSTRACT

Anticipation of stuttering events in persistent developmental stuttering is a frequent but inadequately measured phenomenon that is of both theoretical and clinical importance. Here, we describe the development and preliminary testing of a German version of the Premonitory Awareness in Stuttering Scale (PAiS): a 12-item questionnaire assessing immediate and prospective anticipation of stuttering that was translated and adapted from the Premonitory Urge for Tics Scale (PUTS) (Woods, Piacentini, Himle, & Chang, 2005). After refining the preliminary PAiS scale in a pilot study, we administered a revised version to 21 adults who stutter (AWS) and 21 age, gender and education-matched control participants. Results demonstrated that the PAiS had good internal consistency and discriminated the two speaker groups very effectively, with AWS reporting anticipation of speech disruptions significantly more often than adults with typical speech. Correlations between the PAiS total score and both the objective and subjective measures of stuttering severity revealed that AWS with high PAiS scores produced fewer stuttered syllables. This is possibly because these individuals are better able to adaptively use these anticipatory sensations to modulate their speech. These results suggest that, with continued refinement, the PAiS has the potential to provide clinicians and researchers with a practical and psychometrically sound tool that can quantify how a given AWS anticipates upcoming stuttering events.

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1. Introduction

Stuttering is an involuntary speech fluency disorder that can disrupt normal communication. In severe cases of stuttering this can lead to avoidance behavior, anxiety and other long term negative outcomes extending well beyond speech itself. Adults with persistent developmental stuttering (AWS) commonly report that they are able to anticipate upcoming stutter events – an AWS can often sense that he or she will stutter during the upcoming utterance. This feeling likely occurs even before a planned utterance is fully encoded internally; that is, before linguistic and motor planning is completed and overt speech articulation begins. The anticipation of stuttering events can prompt a variety of reactions within AWS, with various behavioral consequences (Bloodstein, 1960). As such, the ability to detect these sensations accurately can have a variety of applications in research and therapy.

Two types of anticipation can be distinguished: A prospective anticipation refers to the ability of AWS to consciously predict difficult words that will eventually make them stutter. This may happen in recurring situations; for example, in words that are unavoidable yet difficult such as proper nouns – the names of people or places. Studies have found that

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AWS can reliably predict difficult words or parts of speech (Johnson & Solomon, 1937; Milisen, 1938). In an immediate anticipation, AWS often respond instinctively to the sensation of speech fluency disturbances within the relevant speech utterance, leading some to attempt on-the-fly adjustments to speech in order to avoid the dysfluency.

The study of such anticipations goes back a long time. As early as 80 years ago, it was estimated that approximately 85–94% of all occurring stuttering events can be anticipated and that a stuttering event followed 83–96% of reported anticipations – that is to say, anticipations accurately predicted most events and most events were predicted (Johnson & Knott, 1937; Milisen, 1938; Van Riper, 1978). Equally, however, these numbers also indicate that not every anticipation is followed by a stutter, and not all stuttering events are anticipated (Milisen, 1938). Bloodstein (1960) points out that the ability to anticipate upcoming dysfluencies is a skill that develops over time, and that young children may be unable to consciously predict and apprehend an impending stutter. Indeed, the impact of age on anticipation remains unclear – Silverman and Williams (1972), by comparison, showed a reduced capacity for anticipation within their group of 8–16 year olds, as compared with adults; however, they found no group difference for accuracy of predictions between younger and older children. This inconsistency within the literature likely stems from the difference in types of anticipations as mentioned above – prospective and immediate – and thus, as with any skill that requires training and exposure, the potential for conscious anticipations in AWS develops over time. Nevertheless, it is generally agreed that the capacity of AWS to anticipate their stuttering plays a role in stuttering avoidance as well as in various therapies.

In another recent study, Jackson, Yaruss, Quesal, Terranova, and Whalen (2015) collected and categorized written responses to three qualitative questions regarding stutter anticipation from a group of AWS. The authors report high rates of stutter anticipation (77%) in AWS. Moreover, by dividing AWS' responses into action and non-action responses, various ways of behavioral adjustments to stutter anticipation could be identified. These results emphasize the need to develop diagnostic instruments that capture anticipation characteristics in AWS for the individualized stuttering treatments as well as in research on stutter anticipation.

1.1. Therapy that integrates anticipation

While a lot of research has identified anticipations as a key characteristic of stuttering, only one mainstream therapy focuses on anticipations as one of the core components of interest. *Stuttering modification* or “non-avoidance therapy” (Van Riper, 1978) is one of the most well known and effective stuttering treatments; it stands alone as one which refines a patient's ability to anticipate upcoming stuttering events. Recent treatment studies document the efficacy of stuttering modification therapy: Prüß and Richardt (2015) found that most participants reported improved verbal and personal outcomes. Euler, Lange, Schroeder, and Lange (2014) showed that, of AWS who attended stutter therapy in Germany, those who underwent treatment that combined stuttering modification therapy with a therapy using *Fluency Shaping* profited most (for effectiveness studies on stutter modification treatment, see Blomgren, Roy, Callister, & Merrill, 2005; Breitenfeldt & Girson, 1995). These therapies emphasize that it is especially important in stuttering therapy to identify a patient's capacity, manner and style of anticipation. However, in an examination of the stuttering literature to date, no standardized assessment or scale exists to aid therapists in the examination of premonitory sensations in stuttering patients. In order to find an appropriate basis for a questionnaire on stuttering anticipation, we extended our search to disorders with similar characteristics. This led to the identification of tic disorders as an appropriate point of reference.

1.2. Similarities between tic disorders and stuttering

Tic disorders share many similarities with persistent developmental stuttering. Tic disorders, as stuttering, typically have their onset during childhood and often undergo spontaneous remission later in childhood (Döpfner, Roessner, Woitecki, & Rothenberger, 2010; Yairi & Ambrose, 1999). Within individuals, the symptoms can fluctuate over time in the short and long term, and are also influenced by emotional state (Döpfner et al., 2010). Tic disorders, like stuttering, do not differ by cultural or ethnic background (e.g., Robertson, 2008). Likewise, there is a male to female ratio of approximately 3:1 and a strong genetic factor in tic disorders (e.g., Devinsky & Geller, 1999) and stuttering (e.g., Yairi, Ambrose, & Cox, 1996). When examining tic disorders, Brady (1991) found a significant hypoactivation of the left hemisphere and hyperactivation of the right hemisphere motor areas. The same pattern has been found for stuttering (e.g., Sommer, Koch, Paulus, Weiller, & Büchel, 2002).

Additionally, two key studies have recently examined the similarities between the two disorders: Mulligan, Anderson, Jones, Williams, and Donaldson (2003) found that the movement disturbances in tics share many similarities with those accompanying stuttering events. Similarly, Tavano, Busan, Borelli, and Pelamatti (2011) noted a high prevalence of stuttering in individuals diagnosed with *Tourette's syndrome*; conversely, however, De Nil, Sasisekaran, Van Lieshout, and Sandor (2005) found conflicting evidence. Of greatest interest, during the creation of the PAiS, is that both tic disorders (Döpfner et al., 2010) and stuttering (e.g., Bloodstein & Bernstein Ratner, 2008) typically include a characteristic sensation preceding the movement disturbance; in tic disorders, this is known as a *premonitory urge*. In tic disorders, these sensations can manifest around the age of 10 (Döpfner et al., 2010), and can potentially precede every tic event.

When examining the clinical characteristics that define stuttering events by AWS, there are both similarities and differences that can be drawn between such events and the equivalent sensations of release (e.g., sneezing or itching) experienced by everyone. If we appropriate the framework from Belluscio, Tinaz, and Hallett (2011), which originally compared tic

patients and controls, premonitory sensations prior to an event are described as uncomfortable sensations that build up and may lead to feelings of distress if not released; this is similar in stuttering. However, unlike in normal release sensations, there is no brief period in which the AWS can suppress the forthcoming event while still accomplishing their precise speech goal.

Similarly, when comparing the clinical characteristics of stuttering and tic urges, the premonitory sensations in both disorders do not occur before all events. They are dissimilar, however, in that the sensations in stuttering do not overwhelm the patient's control – that is to say, unlike in tic disorders, AWS can stop a stuttering event by entirely refraining from any speech action. Patients with tic disorders also typically describe an itching sensation before, and subsequent relief after, the release of a tic event (Leckman & Cohen, 2003); by contrast, neither the prerelease itching nor the subsequent relief sensation are considered typical in stuttering (Alm, 2004). Additionally, in Tourette's syndrome, as suggested by the PUTS questionnaire (Crossley & Cavanna, 2013; Eddy & Cavanna, 2014), the occurrence of premonitory urges correlates with disease severity; whether the same holds true for stuttering individuals remains under debate.

It is difficult to make a comparison between the respective pathophysiologies of the premonitory sensations in tic disorders and stuttering, as imaging results and neurophysiological results on movement related cortical potentials are conflicting in tic disorders and scarce in stuttering (Jackson, Parkinson, Kim, Schüermann, & Eickhoff, 2011; Rajagopala, Serib, & Cavanna, 2013; Vanhoutte et al., 2015).

1.3. The premonitory urge in tics scale

Most people affected with Tourette's syndrome report that their tics are often preceded by a premonitory urge, meaning an uneasy sensation inside their body. This unpleasant feeling might influence the execution of the tics themselves (Woods, Piacentini, Himle, & Chang, 2005).

Woods et al. (2005) developed the *Premonitory Urge for Tics Scale* (PUTS) to allow for a standardized test of these anticipatory sensations. This instrument tests for different characteristics of the premonitory urges and was evaluated by Crossley, Seri, Stern, Robertson, and Cavanna (2013). Results showed significant correlations between the overall score of the PUTS and the overall severity score of the Tourette syndrome, for the group of participants older than 10 years of age. Taken together, against the background of the similarities between tic disorders and stuttering, the positive evaluation of the PUTS and the necessity of an instrument to quantify stutter anticipation in AWS, the Premonitory Awareness in Stuttering Scale (PAiS) was developed.

2. Material and methods

2.1. Development of the Premonitory Awareness in Stuttering Scale (PAiS)

A pilot version of the PAiS was derived from the PUTS (Woods et al., 2005) and translated into German. In most items, phrasing from the PUTS was directly translated, and the term *tic* was replaced with *stuttering* throughout the questionnaire. Additionally, certain items were rephrased to better reflect the experience of stuttering.

The pilot PAiS consisted of 9 items ranging on a 4-point Likert scale from *gar nicht* [not at all] to *sehr* [very much]. These items included statements describing the extent to which a premonitory feeling is detected or noticed in different situations. The pilot study was completed during the 40th Congress for Stuttering People which took place in Bielefeld, Germany, in October 2013. The study was approved by the ethics committee of the University Medical Center Göttingen. Written informed consent was obtained from all participants. Fifteen conference attendees who stutter volunteered to participate in this pilot study by completing the PAiS and a feedback questionnaire (e.g., *How suitable is the formulation of items in the PAiS? Would you reformulate one or more items? Which question is missing on the questionnaire? Which items would you label as unnecessary?*). The results and feedback from this pilot study were incorporated into the present 13-item version of the PAiS, by adding, rephrasing and removing items. (See Appendix A for the English version of the final 13-item PAiS Scale). Means and standard deviations for each item for the AWS group are presented in Table 2.

2.2. Psychometric validation

For the formal validation of the PAiS, we selected native speakers of German between 18–60 years of age. Inclusion criteria were as follows:

- a diagnosis of stuttering verified by a speech and language pathologist;
- no comorbid neurological or psychological disorders (e.g., aphasia, tic disorders, depression, epilepsy, bipolar disorder);
- no hearing or vision disorders;
- no speaking or language disturbances other than stuttering;
- adequate reading ability; and,
- no drug addictions including alcohol and prescription medications.

Table 1
Stutter Severity Measurements.

	Subjective Measurement		Objective Measurement									
	Self-report scale Score		SSI-4 score		% of stuttered syllables		Frequency		Durations		Physical Concomitants	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
AWS	4.6	1.5	20.05	8.34	10.34	8.29	8.19	1.01	7.33	2.71	4.95	3.53
ANS	n.a.	n.a.	2	0	0.47	0.032	2	0	2	0	0	0

Note: The self-report scale ranged from 1 = leicht [very mild] to 9 = sehr ausgeprägt [very severe]; M = Mean; SD = standard deviation; AWS = adults who stutter; ANS = adults who do not stutter; SSI-4 scores range from 10–36: scores from 10–17 are severity equivalent to “very mild”, from 18–24 to “mild”, from 25–31 to “moderate”, and from 32–36 to “severe”.

Table 2
Means and Standard Deviations for individual items of the PAiS in AWS.

Nr	Item	M	SD
01	Right before I stutter, I can sense that I am about to stutter.	2.10	0.62
02	Right before I stutter, I feel like my insides are itchy and tickly.	0.29	0.56
03	Right before I stutter, I feel pressure inside my brain or body.	1.62	0.97
04	Right before I stutter, I feel tense.	2.19	0.60
05	Right before I stutter, I feel like something is not ‘just right’.	1.57	0.98
06	Right before I stutter, I feel like there is energy in my body that needs to get out or that is blocked.	1.14	0.79
07	In rather relaxed situations, I always have anticipatory sensations before I stutter.	1.24	1.00
08	In rather tense situations, I always have anticipatory sensations before I stutter.	1.81	0.81
09	These feelings happen every time before I stutter.	1.38	0.86
10	The anticipatory sensation allows me to avoid the upcoming stutter event by remaining silent.	1.14	1.15
11	The anticipatory sensation allows me to avoid the upcoming stutter event by saying something else.	1.52	0.93
12	After I stutter, the itchiness, pressure, energy, tense feelings or feelings that something isn’t “just right” go away, at least for a while.	1.71	1.06
13	I really mind that I stutter.	2.14	.91

Note. On the Premonitory Awareness for Stuttering Scale (PAiS), a score of 0 = “not at all true,” 1 = “a little true,” 2 = “pretty much true,” 3 = “very much true.”; M = Mean; SD = standard deviation.

Participants with stuttering were recruited from the Kasseler Stottertherapie (KST) centre and the local self help groups in Bielefeld, Göttingen and Münster. The participants from the therapy centre were tested on the first or second day of their attendance at the KST intensive course, in order to minimize any effect of the treatment on the PAiS. Twenty-one participants, two women and 19 men, provided data for the PAiS validation. The age of participants ranged from 18 to 59 (mean = 31.2, SD = 11.4).

In addition, 21 ANS (two women and 19 men) aged from 18 to 60 (mean = 31.1, SD = 12.0) were recruited and matched for age, sex and highest level of education, with the same inclusion criteria as AWS above, except for the diagnosis of stuttering. We opted to include a group of ANS as control group to examine whether the anticipation of dysfluencies is, in fact, specific to AWS and not a common error predicting mechanism. ANS were recruited from Bielefeld University and the surrounding region of Bielefeld, using the inclusion and exclusion criteria listed above except for stuttering. The ANS group was tested using an adapted version of the final PAiS questionnaire in which all instances of the terms *stutter/stuttering* (*stottern*) were replaced with *dysfluencies* (*Unflüssigkeiten*). The non-stuttering participants were verbally informed that the term *dysfluencies* (*Unflüssigkeiten*) was meant to include disruptions of speech (*Stockungen im Sprechfluss*), getting muddled (*Verhaspeln*) and slips of the tongue (*Versprecher*), but that semantic paraphasia (phonologically accurate but semantically incorrect wording, e.g., *bicycle* in the place of *car*) should not be considered a dysfluency in this context.

3. Results

3.1. Assessment of stuttering severity

3.1.1. Subjective Stutter Severity Measurement

The subjective stuttering severity of AWS was assessed based on a self-report scale (from 1–*sehr leicht* [very mild] to 9–*sehr ausgeprägt* [very severe]). The total scores for the group of AWS ranged from 2–7, the mean total score was 4.2 (severity equivalent to “moderate”) see Table 1 for mean and standard deviation.

Table 3
Pearson Correlations.

	SSI-4 score	% of stuttered syllables	PAiS total score
Subjective Severity Score	0.773**	0.594**	−0.118
SSI-4 score		0.775**	−0.207
% of stuttered syllables			−0.519*

Note. Significance is denoted by asterisks: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$.

3.1.2. Stuttering Severity Instrument (SSI-4)

The *Stuttering Severity Instrument 4* (SSI-4; Riley, 2008) is an objective measurement of stuttering severity that was completed by both speaker groups. The total score of the SSI-4 is derived by adding the scores from the *Frequency*, *Durations*, and *Physical Concomitants subscales*. In addition to SSI-4 total and subscale scores, percent syllables stuttered (%SS) was entered in the analyses as an independent measure of severity.

Speaking samples (sequences of spontaneous speech in response to semi-standardized questions) were recorded on digital video camera and coded by a certified speech therapist (the 2nd author). Descriptive statistics for all speaking measures can be found in Table 1. As expected, AWS had a significantly higher mean score on the SSI-4 ($M = 20.05$) than ANS ($M = 2.00$). This difference was highly significant ($t(40) = 8.56$, $p < .001$, Cohen's $d = 3.1$). Again as expected, AWS produced a higher percentage of stuttered syllables ($M = 10.34\%$) compared to ANS ($M = 0.47\%$). This difference was again highly significant ($t(40) = 5.451$, $p < .001$, Cohen's $d = 1.7$), see Appendix B.1 and Appendix B.2 for individual SSI scores for all participants.

3.2. Means and standard deviations of the PAiS

Responses to the 13 items of the PAiS were measured using a 4-point Likert scale ranging from *gar nicht* [not at all] to *sehr* [very much]. Individual items of the PAiS as well as means and SDs for each item are reported in Table 2. Because item 13 was subsequently found to reduce the internal consistency of the PAiS (see internal consistency analysis below) this item was excluded from the subsequent analyses and was not included in the mean of the total scores of the PAiS. For the sample of AWS, the mean PAiS total score was 17.71 ($SD = 5.47$), with total scores ranging between 9 and 29. For the analogously constructed version of the PAiS for ANS, the mean total score was 3.67 ($SD = 4.19$) with total scores ranging between 0 and 14. The difference between the two speaker groups, AWS and ANS, was highly significant ($t(40) = 9.35$, $p < 0.001$, Cohen's $d = 2.9$).

3.3. Internal consistency of the PAiS

Inter-item correlations (internal consistency) of the PAiS were assessed using Cronbach's alpha. For the entire sample of 21 participants, a standardized Cronbach's alpha level of 0.73 was obtained, indicating good internal consistency. Item 13 was found to reduce the overall reliability of the scale and was removed from the item pool. After exclusion of item 13, the reliability analysis was rerun, yielding a standardized Cronbach's alpha level of 0.76. (See Appendix C & Appendix D respectively for the English and German versions of the final PAiS, with item 13 excluded).

3.4. Correlation analyses

Correlation analyses were performed to examine the relationship between PAiS scores and the speech-related variables: *Self-Report Scale Score*, *SSI-4 Total Score*, *Percentage of Stuttered Syllables (%SS)*. All inter-correlations between the subjective (*Self-Report Scale Score*) and objective (SSI-4 and %SS) stuttering measures were significant, with correlations ranging from 0.59 to 0.78. This latter finding indicates that the ability of stutter anticipation is independent of stutter severity. Interestingly, the correlations between the total score of the PAiS and the *Self-Report Scale Score* and between the PAiS total score and the SSI-4 were non-significant, with correlations of -0.12 and -0.21 respectively. There was, however, a significant negative correlation between the total score on the PAiS and the %SS-variable, indicating that AWS with high PAiS scores tended to produce fewer stuttered syllables, see Table 3.

Correlations were performed between all 12 PAiS items and percentage of syllables stuttered in order to determine whether certain questions appeared to be more highly associated with stuttering frequency. Only three items turned out to significantly correlate with the *Percentage of Stuttered Syllables*: item 2 (*Right before I stutter, I feel like my insides are itchy and tickly*), item 5 (*Right before I stutter, I feel like something is not 'just right'*) and item 9 (*These feelings happen every time before I stutter*), see Table 4.

4. Discussion

The final version of the PAiS demonstrates a high internal consistency in the assessment of stuttering individuals. Moreover, the finding of a significant difference between AWS and ANS suggests that stutter anticipation is not a common error predicting mechanism; instead this *premonitory awareness* seems to be a special capacity exclusive to AWS. Stutter antic-

Table 4
Pearson Correlations.

PAiS	% of stuttered syllables
PAiS item 1	−0.422
PAiS item 2	−0.436*
PAiS item 3	−0.316
PAiS item 4	−0.344
PAiS item 5	−0.480*
PAiS item 6	−0.151
PAiS item 7	−0.170
PAiS item 8	−0.186
PAiS item 9	−0.463*
PAiS item 10	−1.76
PAiS item 11	0.078
PAiS item 12	−0.354

Note. Significance is denoted by asterisks: * = $p < 0.05$.

ipation, in fact, may be one of the defining characteristics of stuttering, as is argued for premonitory urges in tic disorders (cf. Devinsky & Geller, 1999). As early as 1938, Johnson and Ainsworth argued that, given that the experience of anticipatory feelings is such a common phenomenon amongst AWS, a theory of stuttering that disregards anticipations will not adequately explain stuttering. Recently, Natke and Alpermann (2010) recognized the influence of stutter anticipation on both the occurrence and the characteristics of secondary symptoms (e.g., physical concomitants like distracting sounds, facial grimaces, movements of the head and/or the extremities; for more details see, for example, Van Riper, 1937). To this day, however, despite scientific interest in the causes and consequences of stutter anticipation and despite agreement among AWS and speech therapists that stutter anticipation is a common epiphenomenon of stuttering, there is still no definition of stuttering that explicitly addresses and includes anticipatory sensations.

4.1. Percentage of syllables stuttered

The inverse relationship between the overall PAiS score and the Percentage of Stuttered Syllables is an interesting observation that requires further study. One hypothesis that accounts for this is that AWS who are more fluent have a better command of their speech *because* of their higher anticipation abilities. In other words, the better AWS are at predicting impending stutters, the more likely they may be to adjust their speech planning/motor behaviors to optimize speech fluency. However, even the PAiS items that asked most explicitly for AWS' conscious reaction to a stutter anticipation (i.e., “to remain silent”, item 10; or to “reformulate the originally intended utterance”, item 11) did not correlate with the *Percentage of Stuttered Syllables*; thus we tentatively conclude that, even for speakers who anticipate impending stutters, this awareness may not necessarily lead to a consciously planned action attempting to prevent this stutter event. Interestingly, the three PAiS items (items 2, 5, and 9, see point 3.4) which did correlate significantly with the fluency parameter (*Percentage of Stuttered Syllables*) all relate to the sensation of *immediate* as opposed to *prospective* anticipation. The primary difference between these two types of anticipation is that immediate anticipation is believed to be less dependent upon specific linguistic items or speaking environments and situations. At present, our knowledge of how accurately AWS detect their stutter events, and the responses or adaptations that are made to premonitory sensations, are not fully understood but may reflect variations in the “introspection” abilities of individual stuttering speakers.

4.2. Limitations of the PAiS

Limitations of the PAiS at the present stage comprise a single validation in a relatively small group of German language speaking adults. It currently lacks age-based norms and a validated translation into English and other languages. It has been argued that the ability to detect upcoming stutter events increases with age (Bloodstein, 1960), though experimental evidence for this claim is lacking. However, the finding that the PUTS only yields internal consistency in older children, but not children below the age of ten, points towards the conclusion that conscious premonitory awareness may, in fact, develop with age as Woods et al. (2005) suggested. Nevertheless, in subsequent research, the utility of the PAiS for children should be explored.

In its current version, the PAiS does not differentiate between prospective and immediate types of anticipation. These more specific characteristics of anticipation should be assessed in a subsequent consultation with the participant to draw a more precise anticipation profile to evaluate the premonitory awareness of AWS in order to inform basic research and apply it to treatment. Moreover, the PAiS does not include information about whether AWS do anything to actively modify their speech when faced with anticipatory sensations. Likewise, there are as of yet no data addressing the relationship between anticipation sensations and actual stuttering; that is, we do not know whether AWS were accurate in identifying their stuttering moments. Whether accuracy of identification is relevant is itself an interesting question that should be addressed in future research.

4.3. Therapy

As a therapy instrument, the PAiS can help to identify a specific profile of response to stuttering anticipations in AWS. As already stated, the degree and manner of anticipation can be indicative of a patient's capacity to respond to the overall stuttering event and thus influence the effectiveness of different therapy techniques. It could identify, for example, whether therapy should focus on the modification approaches that utilize stutter anticipations during treatment through so called *Preparatory Sets* (Van Riper, 1978), i.e., techniques that facilitate speech fluency by applying speech motor adaptations of the utterance that is predicted to induce stuttering (e.g., by reducing speech rate and starting words with a soft voice onset). With practice, adjusting one's speech to anticipated stuttering events will become more and more automated. By focusing speech training on increasing a patient's sensitivity to anticipation events, the patient will likely improve the effectiveness of the stutter modification programs beyond therapy (for discussion of the different programs see Blomgren et al., 2005; Euler et al., 2014).

Another program that incorporates awareness is *Habit Reversal Therapy* (HRT; e.g., Dutta & Cavanna, 2013), which is a form of cognitive behavioral therapy more commonly applied in the treatment of tic disorders. HRT has multiple components that improve self-monitoring of tics, relaxation training, practice of physically competing responses that may help to avoid or disrupt a tic, and motivational techniques (e.g., Himle, Woods, Piacentini, & Walkup, 2006). Stutter therapies could draw on some of these techniques when attempting to improve a patient's awareness training.

One issue that might impede this awareness training is heightened physiological arousal and anxiety during speech. A recent study by Bowers, Saltuklaroglu, and Kalinowski (2012) investigated how anticipatory autonomic arousal and stuttering is interrelated. Skin conductance and heart rate between presentations of previously elicited feared phonemes and the actual occurrence of stuttering were measured. Results showed no direct relationship between anticipatory arousal and stuttering but rather that the omnipresent expectation of stutter creates a generally accelerated level of anticipatory arousal in AWS.

Another study, by Jackson et al. (2015), highlighted the variation in profiles of stuttering. In particular, they identified two main categories differentiated by their response pattern: *non-action* response, which was characterized by mostly negative or passive responses to a stutter event, and *action* response, in which the AWS enacted proactive behavioral strategies in either avoidance or self-management strategies. In this way, the PAiS will allow therapists to draw an individual profile for each patient, incorporating anticipation/awareness and response style, to better tailor therapy to the needs of each patient.

4.4. Future research

The PAiS comes at the forefront of a growing field. It will greatly benefit researchers and therapists alike, but it is not without its limitations. We expect that the limitations of group size will be reduced with ongoing research and broader uptake of the PAiS in both the research and therapy communities. Against the background of more recent studies (e.g., Jackson et al., 2015; Garcia-Barrera & Davidow, 2015), we recommend that future research involving the PAiS should include an additional question; it should appear between the current questions 10 and 11, as follows:

The anticipatory sensation allows me to avoid the upcoming stutter by changing how I am talking.

This question will help to draw a more complete profile of an individual's stuttering. Therapists can also utilize this question; however, we recommend caution in its interpretation, as the PAiS is not yet statistically validated for this expansion.

Further evaluation should also explore the utility of the PAiS for children. More specifically, in its current version, the PAiS only minimally differentiates between prospective and immediate types of anticipation. These more specific characteristics of anticipation should be assessed more fully using qualitative methods in a subsequent study (such as in Jackson et al., 2015). Correspondingly, the ways in which AWS modify their motor plan during moments of anticipation is interesting and may inform current models of speech production and speech motor control (for an outline of a speech production model that integrates stutter anticipation, see Garcia-Barrera & Davidow, 2015). As a therapy instrument, the PAiS may identify a specific response profile that would help the clinician develop a more targeted and individualized treatment program. Finally, increasing a client's sensitivity and positive response to anticipation sensations may be useful to incorporate into therapy and may promote generalization of treatment gains into outside environments.

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Appendix A.

13-item PAiS Scale.

Nr	Items
(01)	Unmittelbar bevor ich stottere, kann ich spüren, dass ich stottern werde. [Right before I stutter, I can sense that I am about to stutter.]
(02)	Unmittelbar bevor ich stottere, fühlt es sich an, als würde es in mir jucken oder kribbeln. [Right before I stutter, I feel like my insides are itchy and tickly.]
(03)	Unmittelbar bevor ich stottere, fühlt es sich an, als wäre ein Druck in meinem Hirn oder in meinem Körper. [Right before I stutter, I feel pressure inside my brain or body.]
(04)	Unmittelbar bevor ich stottere, fühle ich mich angespannt. [Right before I stutter, I feel tense.]
(05)	Unmittelbar bevor ich stottere, fühlt es sich an, als wäre irgendetwas nicht in Ordnung. [Right before I stutter, I feel like something is not 'just right'.]
(06)	Unmittelbar bevor ich stottere, fühlt es sich an, als sei eine Energie in meinem Körper, die raus muss oder blockiert wird. [Right before I stutter, I feel like there is energy in my body that needs to get out or that is blocked.]
(07)	In eher entspannten Situationen habe ich diese Gefühle fast immer, bevor ich stottere. [In rather relaxed situations, I always have anticipatory sensations before I stutter.]
(08)	In eher angespannten Situationen habe ich diese Gefühle fast immer, bevor ich stottere. [In rather tense situations, I always have anticipatory sensations before I stutter.]
(09)	Diese Gefühle treten vor jedem Stotterereignis auf, das ich habe. [These feelings happen everytime before I stutter.]
(10)	Dieses Vorgefühl erlaubt es mir, das nachfolgende Stotterereignis zu vermeiden, indem ich schweige. [The anticipatory sensation allows me to avoid the upcoming stutter event by remaining silent.]
(11)	Dieses Vorgefühl erlaubt es mir, das nachfolgende Stotterereignis zu vermeiden, indem ich etwas anderes sage. [The anticipatory sensation allows me to avoid the upcoming stutter event by saying something else/different.]
(12)	Wenn ich gestottert habe, verschwinden das Jucken, die Energie, der Druck, die Anspannung oder die Gefühle, oder nicht vollständig wäre – zumindest für eine gewisse Zeit. [After I stutter, the itchiness, energy, pressure, tense feelings or feelings that something isn't "just right" go away, at least for a while.]
(13)	Es stört mich sehr, dass ich stottere. [I really mind that I stutter.]

Appendix B.1.

Stutter Severity Scores for all individual participants in the AWS group.

AWS	Age	Sex	Stutter onset (years of age)	Stutter severity self-estimate	SSI-4 Score	SSI-4 Fre- quency	SSI-4 Duration	SSI-4 Physical Concomitants	Stuttered syllables
AWS.01	18	m	3	5	19	5	6	8	4,1
AWS.02	23	m	6	7	32	6	12	14	6,6
AWS.03	21	m	3	6	19	6	8	5	6,4
AWS.04	26	m	5	5	26	9	8	9	28
AWS.05	26	f	5	3	5	3	2	9	2,2
AWS.06	33	m	4	5	16	7	8	1	8,3
AWS.07	20	m	5	4	16	8	6	2	13,1
AWS.08	31	m	8	7	25	8	10	7	21,4
AWS.09	24	m	3	4	11	4	6	1	3,6
AWS.10	43	m	3	5	28	8	12	8	20,3
AWS.11	39	m	6	7	37	18	12	7	22,9
AWS.12	23	m	6	3	11	4	6	1	3,7
AWS.13	26	m	4	4	16	4	6	6	2,9
AWS.14	20	m	5	5	18	6	8	4	6,5
AWS.15	21	f	3	4	15	8	6	1	3,8
AWS.16	39	m	4	5	21	1	6	1	11
AWS.17	44	m	4	2	11	4	4	3	1,4
AWS.18	30	m	5	3	24	14	8	2	10,7
AWS.19	38	m	3	6	33	16	10	7	21,7
AWS.20	59	m	5	2	12	4	4	4	1,4
AWS.21	52	m	3	5	26	16	6	4	17,1

Appendix B.2.

Stutter Severity Scores for all individual participants in the ANS group.

ANS	age	sex	Stutter onset (years of age)	Stutter severity self-estimate	SSI-4 Score	SSI-4 Fre- quency	SSI-4 Duration	SSI-4 Concomitants	Stuttered syllables
ANS.01	25	f	n.a	n.a.	2	n.a.	n.a.	n.a.	,6
ANS.02	23	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,8
ANS.03	25	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,6
ANS.04	33	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,6
ANS.05	29	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,0
ANS.06	18	m	n.a	n.a.	2	n.a.	n.a.	n.a.	1,4
ANS.07	38	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,0
ANS.08	20	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,3
ANS.09	23	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,3
ANS.10	27	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,6
ANS.11	32	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,6
ANS.12	19	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,3
ANS.13	26	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,6
ANS.14	54	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,3
ANS.15	46	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,5
ANS.16	44	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,3
ANS.17	41	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,3
ANS.18	20	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,5
ANS.19	18	f	n.a	n.a.	2	n.a.	n.a.	n.a.	,4
ANS.20	60	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,0
ANS.21	31	m	n.a	n.a.	2	n.a.	n.a.	n.a.	,8

Appendix C.

Premonitory Awareness of Stuttering Scale (PAiS).

Name

Age

Date

Nr	How I feel	Not at all	A little	Pretty much	Very much
(01)	Right before I stutter, I can sense that I am about to stutter				
(02)	Right before I stutter, I feel like my insides are itchy and tickly				
(03)	Right before I stutter, I feel pressure inside my brain or body				
(04)	Right before I stutter, I feel tense				
(05)	Right before I stutter, I feel that something is not 'just right'				
(06)	Right before I stutter, I feel like there is energy in my body that needs to get out or that is blocked				
(07)	In rather relaxed situation, I always have anticipatory sensations before I stutter				
(08)	In rather tense situation, I always have anticipatory sensations before I stutter				
(09)	These feelings happen every time before I stutter				
(10)	The anticipatory sensation allows me to avoid the upcoming stutter event by remaining silent				
(11)	The anticipatory sensation allows me to avoid the upcoming stutter event by saying something else				
(12)	After I stutter, the itchiness, energy, pressure, tense feelings or feelings that something isn't "just right" go away, at least for a while				
	Total score (on a scale from 0-3, ranging from <i>not at all</i> to <i>very much</i>)				

Appendix D.

German version.

Premonitory Awareness of Stuttering Scale (PAiS).

Name

Alter

Datum

Nr	Wie ich mich fühle	Gar nicht	Ein bisschen	Ziemlich	Sehr
(01)	Unmittelbar bevor ich stottere, kann ich spüren, dass ich stottern werde.				
(02)	Unmittelbar bevor ich stottere, fühlt es sich an, als würde es in mir jucken oder kribbeln.				
(03)	Unmittelbar bevor ich stottere, fühlt es sich an, als wäre ein Druck in meinem Hirn oder in meinem Körper.				
(04)	Unmittelbar bevor ich stottere, fühle ich mich angespannt.				
(05)	Unmittelbar bevor ich stottere, fühlt es sich an, als wäre irgendetwas nicht in Ordnung.				
(06)	Unmittelbar bevor ich stottere, fühlt es sich an, als sei eine Energie in meinem Körper, die raus muss oder blockiert wird.				
(07)	In eher entspannten Situationen habe ich diese Gefühle fast immer, bevor ich stottere.				
(08)	In eher angespannten Situationen habe ich diese Gefühle fast immer, bevor ich stottere.				
(09)	Diese Gefühle treten vor jedem Stottereignis auf, das ich habe.				
(10)	Dieses Vorgefühl erlaubt es mir, das nachfolgende Stottereignis zu vermeiden, indem ich schweige.				
(11)	Dieses Vorgefühl erlaubt es mir, das nachfolgende Stottereignis zu vermeiden, indem ich etwas anderes sage.				
(12)	Wenn ich gestottert habe, verschwinden das Jucken, die Energie, der Druck, die Anspannung oder die Gefühle, oder nicht vollständig wäre – zumindest für eine gewisse Zeit.				
	Gesamtpunktzahl. (auf einer Skala von 0–3, von <i>gar nicht</i> bis <i>sehr</i>).				

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