This is the *Accepted Manuscript* of an article published by Folia Phoniatrica et Logopaedica, 69:180:189

https://doi.org/10.1159/000486032

Speaker and Observer Perceptions of Physical Tension During Stuttering

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Abstract

Purpose: Speech-language pathologists routinely assess physical tension during evaluation of those who stutter. If speakers experience tension that is not visible to clinicians, then judgments of severity may be inaccurate. This study addressed this potential discrepancy by comparing judgments of tension by people who stutter and by expert clinicians to determine if clinicians could accurately identify the speakers' experience of physical tension.

Method: Ten adults who stutter were audio-video recorded in two speaking samples. Two board-certified specialists in fluency evaluated the samples using the Stuttering Severity Instrument-4 and a checklist adapted for this study. Speakers rated their tension using the same forms, then discussed their experiences in a qualitative interview so themes related to physical tension could be identified.

Results: The degree of tension reported by speakers was higher than that observed by specialists. Tension in parts of the body that were less-visible to the observer (chest, abdomen, throat) was reported more by speakers than by specialists. The thematic analysis revealed that speakers' experience of tension changes over time and that these changes may be related to speakers' acceptance of stuttering.

Conclusion: The lack of agreement between speaker and specialist perceptions of tension suggests that using self-reports may be a necessary component for supporting the accurate diagnosis of stuttering.

Keywords: Stuttering, Tension, Self-Report, Assessment, Treatment

1.0 Introduction

1.1 Physical Tension and Stuttering Severity

Physical tension is a central aspect of a speaker's experience of stuttering [1, 2]. Tension is often assessed during diagnostic evaluations and addressed in treatment. Physical tension that can be observed by listeners has been shown to vary from person to person [3-5], and it can occur in different locations, including the muscles of the respiratory, phonatory, or articulatory systems [4, 6]. Increased physical tension may result from a desire to maintain fluency, to push through a moment of stuttering, or to stop a moment of stuttering once it has begun [6]. Physical tension may also be increased when a person reacts to external factors, such as listener reactions and time pressures [1, 6-9]. It may also be increased in response to internal factors, such as the anticipation and learned avoidance of stuttering [6, 10, 11]. Regardless of the cause, increased physical tension is clinically significant because it is one aspect of the behavior that typically contributes to the assessment of stuttering severity [12, 13].

Few published research studies have examined physical tension during stuttering using the reports of people who stutter. Snidecor [4] evaluated the self-reports of physical tension of 17 people who stutter (one female and sixteen males). Physical tension was most frequently reported in the jaw, front of the tongue, front of the throat, inside or back of the throat, the chest, and the abdomen; no one area was reported by all participants. These frequently experienced locations were also judged to be more physically tense during stuttering than other areas of the body. No study as yet has replicated these findings or compared the reports of people who stutter to the observations of listeners (such as speech-language pathologists) who routinely assess physical tension during stuttering as part of a diagnostic evaluation. Listener evaluation of physical tension is one of the 3 components of the Stuttering Severity Instrument [14] measures

the severity of so-called physical concomitants in terms facial grimaces, distracting sounds, head movements, and movements of the extremities. The reliability of the SSI-4 has been shown to be suspect [15]. The aspects of physical tension evaluated in the SSI-4 do not encompass all of the locations reported by speakers [4], so it is possible that listener observations and speaker experiences of locations and degrees of physical tension do not align.

Instrumental measures may provide one way of assessing physical tension during moments of stuttering. Much research has tried to measure the physiological correlates of tension and muscle activity in people who stutter. Shaprio [16] stated that, while no particular relationship exists between disfluency and degree of tension, all moments of stuttering are accompanied by increased and variable muscle tension. In contrast, other research has illustrated how moments of stuttering are not typically characterized by increased levels of tension in laryngeal muscles when evaluated through electromyography (EMG) [17]. The same results have been found with muscle activity of the lower and upper lips [18]. Though EMG amplitude may be the same for moments of stuttering and moments of fluent speech, oscillations of muscle activity in some muscles may differ between moments of stuttering and moments of fluent speech, suggesting variability between the speech patterns of adults who stutter [19]. These patterns may be true of laryngeal muscles [20], as well as more visible muscle systems [19]. Most instrumental evaluations of tension have used measurements of single muscles in specific speaking tasks. Because people who stutter often experience tension in multiple areas and with varying degrees of tension [4], there is a possible discrepancy between what a speaker experiences during moments of stuttering, what instrumentation is able to record, and what observers can perceive. More information is needed about speakers' experiences of stuttering and how those perceptions align with clinician observations.

1.2 Observer-Based Measures vs. Self-Reports

Assessments of physical tension are dependent on the clinician's observations. Martin and Haroldson [12] showed that judges assess stuttering severity differently when presented with audio, visual, or combined audiovisual information. If clinicians judge severity differently depending upon how they view a sample, then observation bias may affect judgments of stuttering behaviors that are more or less visible or audible to listeners. Self-reports of people who stutter may be one answer to this problem. In many areas of the field, the self-reports of people who stutter have become an important method in diagnostic evaluations and research settings to capture difficult or impossible to observe behaviors and characteristics [see 21, 22]. In areas such as quality of life, the reports and insights of people who experience a condition are vital to assessment and intervention [23]. Still, self-reports are not widely used to measure stuttering behaviors. It is unknown to what degree the observations of clinicians and the experiences of speakers align in regard to physical tension. Although some authors have questioned the ability of speakers to accurately quantify and differentiate stuttering experiences [24, 25], the fact that speakers report these experiences suggests that such self-reports are clinically meaningful—at least to the speakers themselves.

Interestingly, no prior studies have compared clinician and speaker perceptions of physical tension experienced during moments of stuttering. Given that tension may occur in parts of the body that are less visible to clinicians, it is likely that a clinician's observations may overlook some clinically relevant aspects of speaker's physical experience of stuttering. If clinicians are in fact missing clinically relevant aspects of physical tension, then self-reports of people who stutter may lead to better diagnostic and therapeutic outcomes. Therefore, the primary purpose of this study was to compare the self-reports of physical tension experienced by

people who stutter with traditional clinician-based observations, such as those used in common standardized assessments [e.g. 13]. A secondary objective was to explore speakers' self-reports and clinicians' observations of tension using interviews and a checklist reflecting various location and degrees of perceived physical tension in order to support improvements in diagnosis and treatment of physical tension associated with moments of stuttering.

2.0 Methods

2.1 Participants

2.1.1 People Who Stutter

Ten people who stutter (five females and five males) were recruited through personal contacts of the first and last authors, both speech-language pathologists who are active in the community of people who stutter. The mean age for 9 of the 10 participants was 44 years, with a range of 23 to 76 years. (One participant elected not to provide biographical data, including age.) All participants who stutter reported onset of stuttering during childhood, and their life experiences of stuttering were judged by the authors to be comparable to those of others who stutter [2, 26]. Participants reported having undergone treatment during childhood, as adults, or both, using a range therapy techniques, including fluency shaping, stuttering modification, and intensive programs. Three were still undergoing treatment at the time of this study. Nine of the participants who stutter were also members in a local chapter of the National Stuttering Association. The University Institutional Review Board approved the study and informed consent was obtained from all participants prior to their participation.

2.1.2. Speech-Language Pathologists

Two speech language pathologists holding the certificate of clinical competence in speech-language pathology (CCC-SLP) and board-certification as specialists in fluency disorders

(BCS-F) were recruited as judges based on personal contacts of the last author. Both gave informed consent prior to their participation in the study. The use of two specialist clinicians is consistent with prior literature reflecting the appropriateness of using judgements from highly trained listeners for diagnosing and treating stuttering [see 27, 28].

2.2 Data Collection and Analysis

Quantitative data in this study were based on: (a) analysis of two speaking tasks (b) scores from the SSI-4, and (c) a "tension checklist" developed for this study. A third speaking task was undertaken for qualitative analysis (described below). The SSI-4 was administered according to protocols outlined in the manual [14]. To examine the different locations in which speakers might experience tension, a checklist was created based on the work of Snidecor [4], who described speaker reports of tension in various parts of the body. The adapted checklist indicated 8 locations where physical tension might occur in a speaker's body, with an eight-point equal-appearing interval scale indicating lower tension to higher tension in each location within the body. If no tension was felt or observed in a particular part of the body, then speakers and specialists were asked to leave the corresponding item blank, and the item was scored as a 0 in subsequent analyses. A score of 1 was considered the least tension, while a score of 7 was considered the highest tension. Locations listed were eyes, lips, tongue, cheeks, throat, vocal folds, chest, and abdomen. Participants and specialists both rated how much tension they perceived or observed in each speaking task using the scale. The tension checklist is presented in the Appendix.

2.2.1 Speaking Tasks

The ten participants who stutter engaged in three audio and video-recorded speaking tasks: (a) a spontaneous speech sample, (b) an oral reading task, and (c) a guided interview that

also served as a second spontaneous conversation task. The order of the tasks was consistent across participants. The SSI-4 was administered before the tension checklist so responses would not be biased by the completion of the more detailed tension checklist.

The spontaneous speaking task consisted of a monologue of 150-300 uninterrupted syllables, collected in accordance with the instructions in the SSI-4 [14]. The first author started by asking participants to talk about their jobs. Additional prompts were provided as needed to encourage the speakers to keep talking and provide samples of adequate length. The oral reading task involved a passage selected at random from the set of readings for adult in the SSI manual (passages XI, XII, XIII, or XIV) [14, pp 49-57]. Each passage ranged in length from 160 to 378 syllables.

The first author conducted the guided interviews and the transcripts were used for thematic analysis as described below. Participants were asked, "What is your experience of physical tension during stuttering?" The first author was careful to keep the focus on physical tension as opposed to other types of tension (e.g. psychological). During the interviews, the first author used the strategies of summarizing, reflecting, and clarifying for understanding [29]. Questions such as the following were asked.

- What does the tension feel like, physically?
- Does your experience of physical tension change?
- What do you think other people see when you are experiencing physical tension?
- How long does the sensation of physical tension seem to last?
- Is there anything that you can do to reduce the sensation of physical tension?

The interviews lasted approximately 15-30 minutes, though no time constraint was imposed so speakers would have the opportunity to say what they wanted without possible confounds of time pressure [see 30].

2.2.2 Speaker Self-Rating Tasks

Prior to completing the spontaneous speech and oral reading samples, speakers were informed that they could use their own perceptions and experiences of the previous speech samples and the observations of the video recording to rate their physical tension. This coincided with the goal of the study to examine the speakers' experience of physical tension as accurately as possible. Research has shown that speakers become less accurate in reporting the experience of stuttering if enough time has passed [31, 32]. Therefore, after these samples were recorded, the participants immediately watched the speech and reading samples and rated themselves using the physical concomitant section of the SSI-4. Importantly, the participants who stutter had access to their immediate experience of physical tension having just made the audio-visual sample with the video serving as a reminder. The total time between the completion of sample creation and starting the self-rating task with the audio-visual reminder was less than 10 seconds, the time required to start playback of the audio-visual file. Participants then viewed the samples a second time immediately upon completing the first pass and rated themselves using the tension checklist described above. The total time to complete both the physical concomitant section and the physical tension checklist was less than 5 minutes for all participants.

2.2.3 Specialists' Tasks

The two stuttering specialists viewed the recordings of the oral reading task and spontaneous speech samples of each participant. For each participant, the specialists rated physical tension using the standard procedures specified in the manual of the SSI-4. The SSI-4

does not operationalize physical concomitants or physical tension outside of the word *distracting,* so no further information was given to the specialists in this study. This ensured that the scoring procedures used by the specialists was similar to that typically employed by clinicians who use the SSI-4. They then viewed the recordings again and rated physical tension using the more detailed checklist. Each specialist rated the samples from all 10 speakers so the scores of the two specialists could be compared across each of the participants who stutter.

2.2.4 Thematic Analysis

Common themes regarding participants' experiences of physical tension were identified following the procedures described by Boyatzis [33]. Each session was transcribed verbatim. The first author reviewed each transcript multiple times, highlighting patterns and organizing them into related themes and sub-themes. Tangential and extraneous comments not pertaining to the topic of the experience of physical tension were excluded from analysis. Participants' disfluencies were not recorded in the transcript, in order to minimize distraction when compiling themes and subthemes [see 29, 30]. Saturation was confirmed through an interview of an additional person who stutters who did not participate in other parts of the experiment to ensure that additional themes were not identified.

2.3. Reliability of Measurements

The last author independently performed a reliability check on all of the transcripts, following the same procedures as the first author. The last author reviewed all of the transcripts to consider themes. Where differences were observed between the original and repeated analyses, a consensus judgment was formed though a discussion about the topics and examples drawn from the verbatim transcripts. One difference between authors' analyses was the theme of change over time. Originally, the first author included change over time as a sub-theme in other

themes. A consensus was formed that change over time should be viewed as a theme in and of itself (see below).

In order to evaluate the reliability of the specialists' measurements, data from two participants who stutter were selected at random and given to both specialists for re-evaluation three weeks after the original assessments were completed. Mean differences were calculated for the SSI-4 and the tension checklist to determine intra-rater reliability between initial and follow-up judgments. Both Specialist 1 and 2 had maximum mean differences of 1 on the SSI-4. This includes the frequency and duration sub-scores, as well as the components of the physical concomitant section (distracting sounds, facial grimaces, head movements, and movements of the extremities). On the tension checklist, which is an equal appearing interval scale, Specialist 1 showed differences between the original and follow-up scores ranging from 0 to 2 points out a maximum possible difference of 10 points. Specialist 2 showed differences ranging from 0 to 1.5 points. Thus, both specialists demonstrated high intra-rater reliability between pre and post measures on both the SSI-4 and the tension checklist.

3.0 Results

3.1. Agreement Between Specialists

3.1.1 SSI-4 Frequency sub-score, Duration sub-score, and SSI-4 Total Overall Score

Table 1 reports the frequency sub-score, duration sub-score, total physical concomitant score, and SSI-4 total overall score for each of the 10 participants who stutter as judged by the two specialists. Since the data were ordinal, a Wilcoxon Matched Pairs test and a Spearman rho were used for analysis. Agreement between the specialists was high for the frequency sub-score (or frequency of stuttering events), with a Wilcoxon Signed-Ranks Pairs test showing no statistically significant difference (Z=0.59, p = .56) and a Spearman's rho revealing a strong

positive correlation (ρ= .97, $p < .001$) between the specialists' judgments. Agreement for the duration (or average length of the 3 longest stuttering events) sub-score was lower; the Wilcoxon revealed statistically significant differences between specialist ratings ($Z = 2.59$; $p = .01$), and the Spearman's rho revealed a significant but only moderately strong positive correlation (ρ =.76, $p = .011$). Lower agreement between specialists was seen for the physical concomitant score. Again, the Wilcoxon Signed-Ranks Pairs test revealed a statistically significant difference (Z= -2.20, $p = .023$), and the Spearman's rho revealed a lower moderate correlation (ρ= .51, $p = .137$). For the SSI-4 total overall score, there was a statistically significant difference ($Z = 2.24$; $p = .025$) between specialists, with a moderately strong significant correlation (ρ = .79, $p = .007$). These reliability measures for the SSI-4 are similar to those previously reported for an earlier version of the SSI [see 15].

3.1.2 Tension Checklist

Figure 1 shows the average tension in each body location perceived by specialists on the physical tension checklist. Agreement between specialists was high for the body locations of the lips and cheeks with both specialists perceiving similar amounts of tension in those areas. The specialists had the greatest disparity in average tension perceived within the vocal folds.

3.2 Agreement between Specialists and Speakers

3.2.1 SSI-4 Physical Concomitant Sub-score

Agreement between speakers and specialists on the total physical concomitant score was evaluated using a Spearman's Rho correlation coefficient. This was appropriate because the data were matched in that they are of the same individual participants. Specialist 1 rated all 10 speakers and each of those speakers rated themselves. Specialist 2 rated all 10 speakers and each of those speakers rated themselves. Thus, the data were dependent. No significant correlation

with speaker data was observed for either specialist (Specialist 1: ρ=.37, p= .30; Specialist 2: ρ=.29, p= .41), suggesting notable differences in how much the speakers and specialists judged the physical tension to be "distracting" (using the wording of the SSI-4 physical concomitant section).

3.2.2 Tension Checklist

Figure 2 reports the number of participants who reported tension in a particular body location. All ten participants reported tension in the eyes. Nine participants reported tension in the lips, tongue, throat, vocal folds, and chest. Eight participants reported tension in the cheeks and abdomen. Figure 2 also reports the number of participants who were judged by specialists to exhibit physical tension in those body locations. For example, both specialists observed tension in the eyes of 5 of the speakers.

Overall, specialists observed all locations of tension less frequently than was reported by speakers. The highest agreement for specialist 1 was the location of the lips. Specialist 1 observed tension in the lips of 8 speakers, while 9 speakers out of 10 speakers reported tension in that location. The highest agreement for specialist 2 was the location of the vocal folds. Specialist 2 observed tension in 7 speakers and 9 speakers reported tension in that area.

3.3 Thematic Analysis

Thematic analysis revealed themes relating to locations of tension in the body, degree, management, perceptions of others, and perception of speakers. Themes are presented in order of most common to least common.

3.3.1 Tension and movement

Speakers discussed tension not only in terms of locations and degrees but also movement. So in addition to reporting areas of tension, speakers discussed tension in more dynamic terms, often with examples.

> Participant 02 (P02): I've seen myself hit myself, tap stuff, [My head moves] back and forth, and from side to side.
>
> P03: I do this [squeezes hands].
>
> P04: I averted my eyes a lot… In my eyes, you squint and your facial muscles tighten up.
>
> P09: Usually very tense around the throat and vocal chords and here [motioned along throat], and the lips…I frequently have a fist clenched when talking.

3.3.2 Specific strategies for managing tension

When asked about their general experience of physical tension, all participants spoke about ways they have attempted to manage or reduce physical tension, including breathing, using light contact, avoiding words or situations, using desensitization therapy, speaking at a slower rate, and trying pharmaceutical remedies. This suggests that management, or at least attempting to manage tension is common among people who stutter. Therapy-specific techniques were often mentioned first. Some strategies mentioned also related to acceptance (see 3.3.3).

> P07: How I've managed is to try and not to avoid at all. That in turn has reduced my physical tension, just the whole acceptance of stuttering-thing. Just being okay with stuttering has reduced my physical tension, I'm still stuttering but I'm not so tight, so tense and just struggling.
>
> P10: I have the speech goals of light contact, easy onset. I don't actually know if they work in isolation, but I know that a belief that they work, whether or not that be true or

false, calms me down, that reduce my anticipatory anxiety, which slows me down, and calms me in speaking situations

3.3.3 Change over time

All participants discussed how their experience of tension has changed over time with regards to factors such as self-perception, acceptance, degrees of tension, location in the body, and difficulty with specific speaking situations.

P06: I don't get that uneasiness in my stomach that I had when I was younger.

P07: It [the amount of tension] has changed a lot over time, in the years since I started stuttering.

P09: Physical tension is not always there; when I was younger it was a lot more…Over the years it's gravitated away from my stomach.

P10: When I stuttered a lot more severely, it was definitely more in my stomach, or more extreme in my stomach.

3.3.4 Thoughts about how others perceive tension

Nine of the ten participants discussed how their views of the perception of others were affected by physical tension in their speech. Some speakers discussed surface-level characteristics, such as overt tension. Others discussed possible negative feelings or reactions on the part of others.

P03: I think they're more taken back because here you are talking and all of a sudden you start blocking they don't know what's happening.

P05: They [my tense areas of chest and vocal cords] are not stereotypic associative patterns of stuttering that an unskilled listener would be aware of.

P06: I think they see abnormalities in the way you form your lips: your lips might be quivering; you might be kind of locked up on a word; blocking.

P09: To the casual viewer, I don't think they notice much minor tension, or minor to them.

P10: I don't think the average man on the street notices tension as much as they notice secondary behaviors. Even when tension is extreme I would argue that secondary behaviors, especially slapping or twitching or whatever, I think that's more expected.

3.3.5 Duration of physical tension

No speaker stated that duration of tension perception or degree of tension perception was consistent. Some discussed how the moment of tension was longer than the length of the stutter itself. There were also differences between what was considered long vs. short durations between speakers. A short duration for one speaker was not a short duration for another speaker. Thus, how one perceives tension or stuttering as a whole may affect the perception of duration.

P01: [It lasts] just a couple of seconds [but] it seems long at the time.

P02: Very long, the blocks can last half a second, they can last several seconds.

P10: In the moment, it definitely lasts longer than the block but it falls off pretty quickly…as I'm blocking it's increasing in intensity and then as the block ends there's some residual tension that remains.

3.3.6 Negative reactions regarding stuttering

Three participants reported that their self-perception was negatively affected by their experience with physical tension.

P03: In real life situations, I struggle because I want to sound normal I don't want to sound so strange so it's like a balancing act.

P04: Sometimes, I just really couldn't control my speech at all, and there I got real upset, and it fed upon itself and that would last afterwards too. I would be really upset for the rest of the day or something. Things like that [affect you and cause you to] get tenser and depressed and everything else.

P10: In general, I don't like seeing myself and I don't also think any person who has an insecurity is going to like to see that insecurity.

3.3.7 Summary of Themes

Analysis of these themes shows the individualized nature of physical tension during stuttering as experienced by speakers. Management strategies varied. Many speakers reported that they have attempted various strategies for managing tension, including fluency shaping techniques, stuttering modification techniques, and avoiding words or situations. The theme of change over time was apparent across many aspects of the experience of tension. Specifically, participants reported body locations where tension occurred, duration of tension, the ability to use management strategies, and the degrees of physical tension changed over time and from situation to situation.

4.0 Discussion

This study sought to compare physical tension as experienced by people who stutter to clinician-based observations of those same moments. The two specialist observers achieved a high degree of agreement with one another for judging the frequency of disfluencies exhibited by participants using the SSI-4. This finding is consistent with research showing that expert or trained clinicians can demonstrate a high degree of reliability when judging fluency counts [34, 35]. Lower agreement was seen between the two experts for their judgments of the duration of disfluencies. Even lower agreement was found for the physical concomitant sub-section of the

SSI-4. Even though clinicians attained a relatively high degree of agreement on frequency of stuttering syllables, agreeing on the degree and locations of physical tension was much more difficult even for expert trained clinicians. These findings provide evidence that people who stutter report more physical tension in terms of location and degree than clinicians can observe. More specifically, agreement on the physical tension checklist differed depending upon the location of tension in the body. Higher agreement between speakers and clinicians was apparent for tension in areas that were more easily seen or heard by listeners (e.g., the eyes, lips, and vocal folds) and lower agreement was found for less-visible locations, such as the throat, abdomen and chest. Tension in the area of the vocal folds may have been associated with higher agreement because of acoustic aspects of stuttered speech observers can hear. This may explain why some areas of physical tension commonly reported by speakers during moments of stuttering are not perceived by specialists and other conversation partners. Because of the low agreement between observers and speakers for certain aspects of physical tension, it seems that purely observer-based measures of physical tension (such as those employed in the SSI-4) underestimate the overall amount of tension a speaker experiences.

Parts of the body mentioned by participants in this study closely paralleled and supported those reported by Snidecor [4]. Speakers consistently discussed specific parts of the body where they felt tension, differing degrees of tension, changes in location and degree of tension over time, and how tension affected their self-perception. The theme of change over time encompassed many aspects of physical tension during stuttering. This is in accordance with literature showing that the frequency and degree of stuttering vary from situation to situation and from day to day [1, 6, 36]. Overall, the consistency of the themes discussed by participants who stutter suggests that the experience of physical tension is common with people who stutter, even

if observers cannot perceive all aspects of it. While it is true that physical tension is usually thought of as a reaction or learned behavior [1, 6], the participants who stutter discussed tension across disfluency types. Because observers may be missing salient aspects of the experience of tension as experienced by speakers, the use of speaker-self reports in the assessment of physical tension during stuttering is warranted.

4.1 Clinical Implications

Treatment of physical tension during moments of stuttering often involves building speaker awareness of where in their bodies they experience tension, so they might change their speaking patterns. Based largely on the work of Van Riper [37], building speaker awareness often involves freezing or holding in the moment to build awareness of areas in the body and degrees of physical tension. Van Riper referred to this stage of therapy as identification, where the person who stutters is exploring what they *do* when they stutter rather than focusing on *what their speech sounds like* [37-39]. Using the self-reports of speakers in *assessing* physical tension, rather than only in treatment, may more naturally lead to building speakers' awareness of what they are doing during specific moments of stuttering and from situation to situation.

4.2 Limitations and Directions for Future Research

This study was a preliminary study into the experience of physical tension during moments of stuttering. Future studies may increase the number of participants—both people who stutter and specialist raters, to ascertain if these effects and themes hold to a larger sample. This study involved having participants rate physical tension on the SSI prior to completing the tension checklist created for this study based on the work of Snidecor (1955). This may have introduced an order effect for the identification of physical tension. Still, the administration order

was selected intentionally so responses on the SSI would not be affected by a more specific list of locations indicated on the checklist.

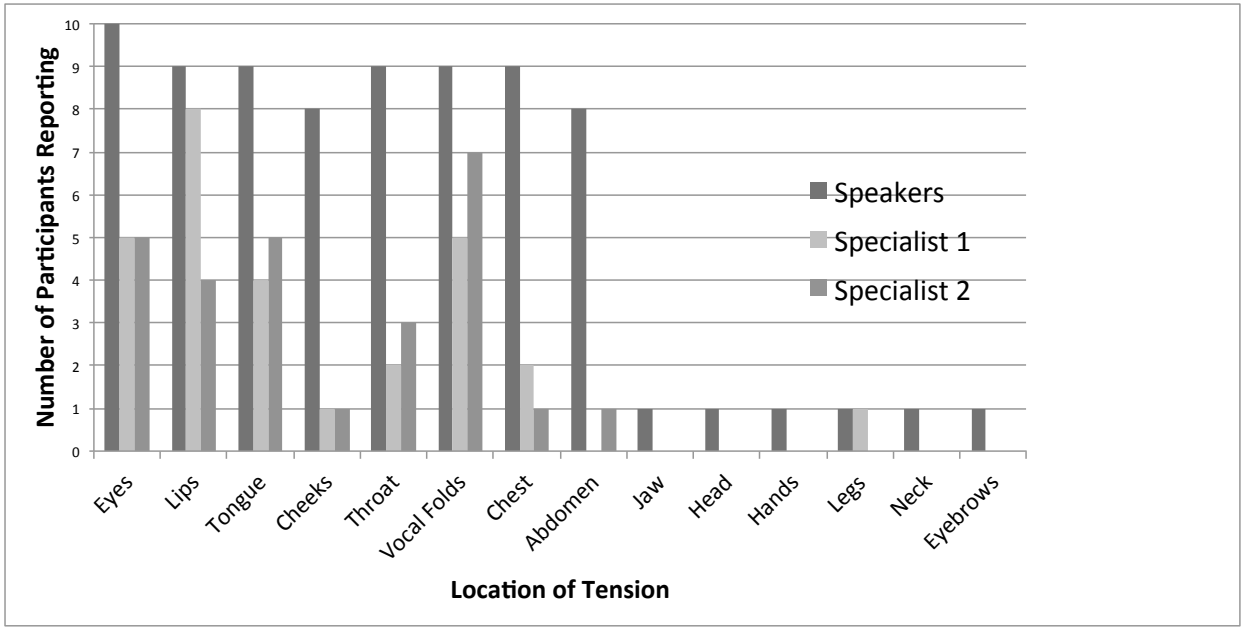
Given the long history of each participant's stuttering experience, there was no indication that participation in this study was the first time viewing themselves stuttering on video. Nonetheless, viewing themselves stuttering on video may have increased the severity of experienced tension. Another possible limitation is associated with the fact that many of the speakers who stutter were active members of a support group organization for people who stutter. These individuals may not be representative of all people who stutter, for they may have different perceptions of their experience of physical tension due to their participation in self-help [26]. Future research should examine the tension experiences of people who have not participated in self-help.

Future research should also seek to identify more objective means of establishing the degree of physical tension experienced by a speaker during moments of stuttered or fluent speech. Still, prior studies have shown that EMG levels of muscle activity in certain muscles and groups do not significantly differ from EMG measurements of people who do not stutter [see 17, 18, 19]. A more objective measure of tension may be possible, though speakers' individualized perceptions of the experience of tension during stuttering would appear to be quite meaningful clinically and should therefore be considered regardless of whether instrumental assessment becomes available.

4.3 Conclusion

Consistent with prior research (Snidecor, 1955), this study showed that individuals who stutter perceive increased levels of physical tension in various parts of their bodies during stuttering. Importantly, expert clinicians were not always able to identify the same degree or

location of tension. More visible areas of the body (e.g., eyes, lips, tongue, and vocal folds) were associated with high agreement, while tension in other areas (e.g., throat, chest, and abdomen) was not consistently detected by expert clinicians. These findings suggest that standard observer-based measures of tension routinely miss relevant aspects of the experience of stuttering commonly experienced by people who stutter. Physical tension during stuttering may be more appropriately evaluated using speaker-based methods, such as self-report. Further research on physical tension is clearly warranted, given that speakers consistently state that it negatively impacts their perceptions about themselves and their quality of life as it relates to stuttering. Future research may lead a new method for measuring perceived physical tension during moments of stuttering that would lead to better diagnostic and therapeutic outcomes.


Number of Participants Reporting
10
9
8
7
6
5
4
3
2
1
0
Speakers
Specialist 1
Specialist 2
Eyes
Lips
Tongue
Cheeks
Throat
Vocal Folds
Chest
Abdomen
Jaw
Head
Hands
Legs
Neck
Eyebrows
Location of Tension

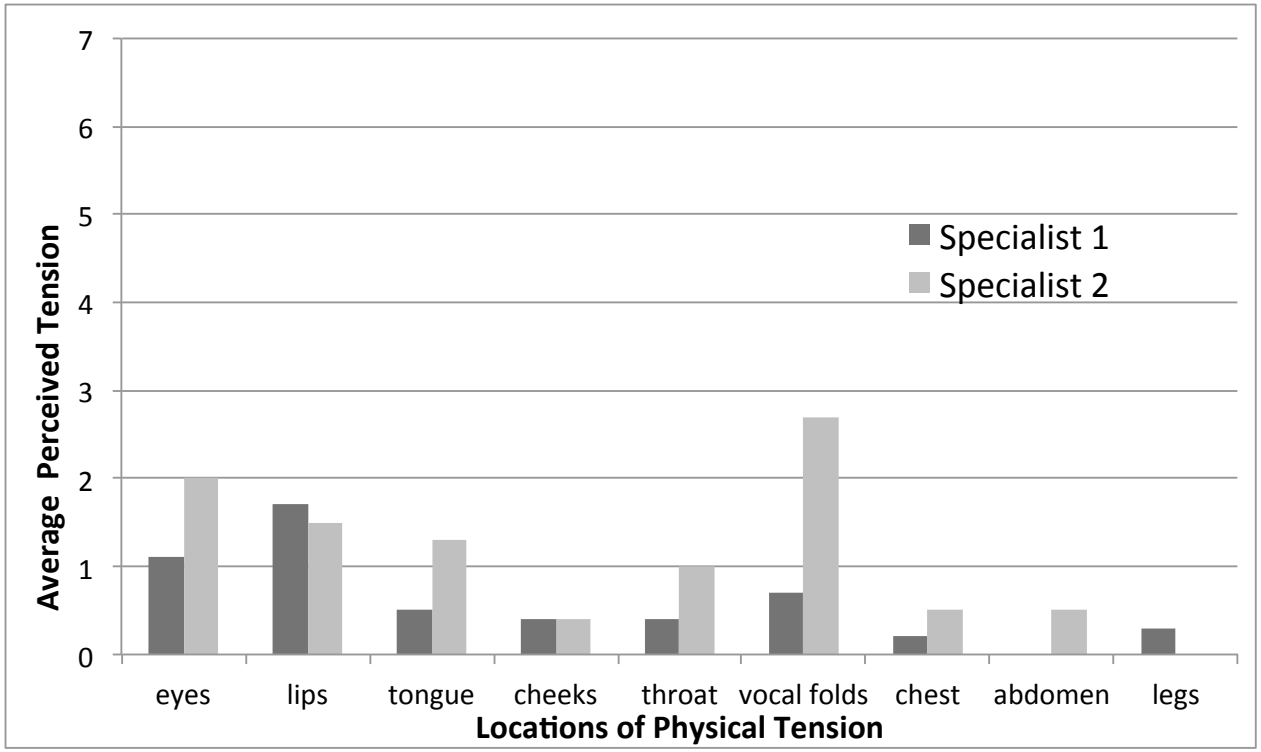

7
6
5
4
3
2
1
0
Average Perceived Tension
Specialist 1
Specialist 2
eyes
lips
tongue
cheeks
throat
vocal folds
chest
abdomen
legs
Locations of Physical Tension

Table 1. Inter-specialist comparisons on the SSI-4 Frequency, Duration, Physical Concomitant, and Total Score

	Frequency		Duration		Physical Concomitant		Total Score	
Speaker #	Specialist 1	Specialist 2	Specialist 1	Specialist 2	Specialist 1	Specialist 1	Specialist 1	Specialist 2
1	6	3	2	4	2	2	10	9
2	6	6	2	2	0	1	8	9
3	5	3	2	2	3	1	10	6
4	9	10	2	6	1	3	12	19
5	11	10	4	8	2	7	17	25
6	6	5	2	4	0	2	8	11
7	15	15	4	8	3	6	22	29
8	17	18	10	14	10	16	37	48
9	8	9	2	8	2	5	12	22
10	3	4	2	6	2	3	7	13
Wilcoxon	Z=0.59; *p*=.56		Z=2.59; *p*=.01		Z= -2.20, ρ=.023		Z= 2.24; *p*=.025	
Spearman	ρ=.97, *p*= .001		ρ= .76, *p*=.011		ρ=.51, *p*= .137		ρ= .79, *p*=.007	
	Median= 7, Range= 15		Median= 4, Range= 12		Median= 2, Range= 16		Median= 12, Range= 42	

Appendix

TENSION CHECKLIST – ADAPTED FROM SNIDECOR (1955)

Participant Number_____ Date _____

Sample- Spontaneous Speech and Oral Reading

Location of the body and degree of physical tension during stuttering

	Least						Most
Eyes	1	2	3	4	5	6	7
Lips	1	2	3	4	5	6	7
Tongue	1	2	3	4	5	6	7
Cheeks	1	2	3	4	5	6	7
Throat	1	2	3	4	5	6	7
Vocal Folds	1	2	3	4	5	6	7
Chest	1	2	3	4	5	6	7
Abdomen	1	2	3	4	5	6	7
_____	1	2	3	4	5	6	7
_____	1	2	3	4	5	6	7
_____	1	2	3	4	5	6	7

_____ 1 2 3 4 5 6 7

_____ 1 2 3 4 5 6 7

Adapted from Snidecor, J. (1955). Tension and facial appearance in stuttering. In W. Johnson (Ed.), *Stuttering in children and adults* (pp. 377). Minnesota: University of Minnesota Press.

Acknowledgements

This paper was completed as part of the first author's master's thesis. The authors are grateful to the participants, as well as to the two specialist raters, for their time and support.

References

1. Bloodstein and N. Bernstein Ratner, *A handbook on stuttering*. 6th ed. 2008, Clifton Park, NY: Thomson/Delmar Learning.
2. Yaruss, J.S. and R. Quesal, *Stuttering and the international clasification of functioning, disability, and health (ICF): an update.* Journal of Communication Disorders, 2004. **37**: p. 35-52.
3. Brutten, E.J. and D.J. Shoemaker, *The modification of stuttering*. 1967, Englewood Cliffs, NJ: Prentice-Hall.
4. Snidecor, J., *Tension and facial appearance in stuttering*, in *Stuttering in children and adults*, W. Johnson, Editor. 1955, University of Minnesota Press: Minnesota. p. 377.
5. Wingate, M.E., *A Standard Definition of Stuttering.* J Speech Hear Disord, 1964. **29**: p. 484-9.
6. Starkweather, C.W., *Fluency and Stuttering*. 1987, Englewood Cliffs, NJ: Prentice-Hall.
7. Bloodstein, *A rating scale study of conditions under which stuttering is reduced or absent.* Journal of Speech and Hearing Disorders, 1950. **15**: p. 26-26.
8. Johnson, W., *Stuttering and what you can do about it*. 1961, Minneapolis, MN: Minnesota Press.
9. Starkweather, C.W. and J. Givens-Ackerman, *Stuttering*. 1997, Austin, Tx: Pro-ed.
10. Johnson, W., *Stuttering*, in *Speech handicapped school children*. 1967, Harper & Row: New York. p. 229-329.
11. Sheehan, J.G., *Tension patterns during stuttering in relation to conflict, anxiety-binding, and reinforcement.* Speech Monographs, 1954. **21**: p. 272-279.
12. Martin, R. and S.K. Haroldson, *Stuttering and speech naturalness: audio and audiovisual judgments.* J Speech Hear Res, 1992. **35**(3): p. 521-8.
13. Riley, G.D., *A stuttering severity instrument for children and adults.* J Speech Hear Disord, 1972. **37**(3): p. 314-22.
14. Riley, G.D., *Stuttering severity instrument (SSI-4)*. 3rd ed. 2009, Austin, Tx: Pro-Ed.
15. Lewis, K., *Do SSI-3 scores adequately reflect observations of stuttering behaviors?* Journal of Speech-Language Pathology, 1995. **4**: p. 46-59.
16. Shapiro, A., *An electromyographic analysis of the fluent and dysfluent utterances of several types of stutterers.* Journal of Fluency Disorders, 1980. **5**: p. 203-231.
17. Smith, A., et al., *Activity of intrinsic laryngeal muscles in fluent and disfluent speech.* J Speech Hear Res, 1996. **39**(2): p. 329-48.
18. de Felicio, C.M., et al., *Comparison of upper and lower lip muscle activity between stutterers and fluent speakers.* Int J Pediatr Otorhinolaryngol, 2007. **71**(8): p. 1187-92.
19. Denny, M. and A. Smith, *Gradations in a pattern of neuromuscular activity associated with stuttering.* J Speech Hear Res, 1992. **35**(6): p. 1216-29.
20. Smith, A., et al., *Spectral analyses of activity of laryngeal and orofacial muscles in stutterers.* J Neurol Neurosurg Psychiatry, 1993. **56**(12): p. 1303-11.
21. Yaruss, J.S. and R. Quesal, *Overall assessment of the speaker's experience of stuttering (OASES): Documenting multiple outcomes in stuttering treatment.* Journal of Fluency Disorders, 2006. **31**: p. 90-115.
22. Yaruss, J.S. and R. Quesal, *Overall Assessment of the Speaker's Experience of Stuttering (OASES).* 2010, Bloomington, MN: Pearson Assessments.

23. Guntupalli, V.K., J. Kalinowski, and T. Saltuklaroglu, *The need for self‐report data in the assessment of stuttering therapy efficacy: repetitions and prolongations of speech. The stuttering syndrome.* International Journal of Language & Communication Disorders, 2006. **41**(1): p. 1-18.
24. Ingham, R.J., et al., *Speech Effort Measurement and Stuttering: Investigating the Chorus Reading Effect.* Journal of Speech, Language, and Hearing Research, 2006. **49**: p. 660-670.
25. Ingham, R.J., et al., *Measurement of speech effort during fluency-inducing conditions in adults who do and do not stutter.* J Speech Lang Hear Res, 2009. **52**(5): p. 1286-301.
26. Yaruss, J.S., et al., *Speech treatment and support group experiences of people who participate in the National Stuttering Association.* J Fluency Disord, 2002. **27**(2): p. 115-33; quiz 133-4.
27. Cordes and R.J. Ingham, *Time-interval measurement of stuttering: establishing and modifying judgment accuracy.* J Speech Hear Res, 1996. **39**(2): p. 298-310.
28. Kully, D. and E. Boberg, *An investigation of the inter-clinic agreement in the identification of fluent and stuttered syllables.* Journal of Fluency Disorders, 1988. **13**: p. 309-318.
29. Bricker-Katz, G., M. Lincoln, and P. McCabe, *Older people who stutter: barriers to communication and perceptions of treatment needs.* Int J Lang Commun Disord, 2010. **45**(1): p. 15-30.
30. Plexico, L.W., W.H. Manning, and H. Levitt, *Coping responses by adults who stutter: part I Protecting self and others.* Journal of Fluency Disorders, 2009. **34**(2): p. 87-107.
31. Martin, R. and S.K. Haroldson, *Stuttering as involuntary loss of speech control: barking up a new tree.* 1986.
32. Moore, S.E. and W.H. Perkins, *Validity and reliability of judgments of authentic and simulated stuttering.* J Speech Hear Disord, 1990. **55**(3): p. 383-91; discussion 394-7.
33. Boyatzis, R.E., *Transforming qualitative information: thematic analysis and code development*. 1998, Thousand Oaks, CA: Sage Publications.
34. Bainbridge, L.A., et al., *The Efficacy of Stuttering Measurement Training: Evaluating Two Training Programs.* Journal of Speech, Language, and Hearing Research, 2015. **58**(2): p. 278-286.
35. Cordes and R.J. Ingham, *Effects of time-interval judgment training on real-time measurement of stuttering.* Journal of Speech, Language, and Hearing Research, 1999. **42**(4): p. 862-879.
36. Constantino, C.D., et al., *A preliminary investigation of daily variability of stuttering in adults.* Journal of communication disorders, 2016. **60**: p. 39-50.
37. Van Riper, C., *The treatment of stuttering*. 1973, Englewood Cliffs, NJ: Prentice-Hall.
38. Sheehan, J.G., *The Modification of Stuttering through Non-Reinforcement.* Journal of Abnormal Psychology, 1951. **46**(1): p. 51-63.
39. Williams, D.E., *A point of view about stuttering.* J Speech Hear Disord, 1957. **22**(3): p. 390-7.

Fig. 1 Average perceived tension reported by specliasts on the Tension Checklist by location
Fig. 2 Frequency of locations reported by each speaker and specialist on the Tension Checklist