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# Student clinicians' physiological reactions to typical and atypical speech before and after participating in an intensive stuttering clinical practicum

Emily A. Erickson

Idaho State University

## Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of JANE STUDENT find it satisfactory and recommend that it be accepted.

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# HUMAN SUBJECTS COMMITTEE APPROVAL

**Idaho State UNIVERSITY**

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921 South 8th Avenue, Stop 8046 • Pocatello, Idaho 83209-8046

May 7, 2014

Daniel Hudock, PhD
MS 8116
CSD
Pocatello, ID 83209

RE: Your application dated 5/22/2014 regarding study number 4113: Evaluation of an Interprofessional Education During an Intensive Stuttering Clinical Practicum

Dear Dr. Hudock:

I agree that this study qualifies as exempt from review under the following guideline: 1. Research on educational practices in educational settings. This letter is your approval, please, keep this document in a safe place.

Notify the HSC of any adverse events. Serious, unexpected adverse events must be reported in writing within 10 business days.

You are granted permission to conduct your study effective immediately. The study is not subject to renewal.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Tom Bailey (208-282-2179; fax 208-282-4723; email: humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergén, PhD, MPH, CIP
Human Subjects Chair

Phone: (208) 282-2179 • Fax: (208) 282-4723 • www.isu.edu/research

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## ABSTRACT

The current study examined student clinicians' physiological reactions to atypical speech. It was hypothesized that there would be a reduction in physiological arousal while watching atypical speech for graduate students after participating in an intensive fluency clinic. Skin conductance (SC) and heart rate (HR) changes were analyzed from 12 graduate student clinicians while watching videos of fluent and atypical speech. A multivariate analysis was conducted to examine the effect of speaker, speaker category, and time on SC and HR. A significant difference was found for HR for speaker category, and trends were revealed for time, and interaction effect between speaker and time. Contrary to previous research, significant differences, or trends toward significance for skin conductance were not revealed. The results indicate that listeners' experience, training, familiarity with the speaker, and speaker age or behavior may affect reactions to atypical speech.

# CHAPTER I: INTROCUCTION

## Communication

Communication is a complex and interactive process that takes place between two or more individuals as a means of exchanging information (Wiener, Devoe, Rubinow, & Geller, 1972). The sender-receiver dynamic during communication is a continuous interaction involving both auditory and visual gestures that include many components such as: prosody and rhythm of voice, facial expressions, gross body posture, head position, and eye gaze (Buck & VanLear, 2002; Wiener et al., 1972). These auditory and visual signals may also hold communicative significance by way of their relationship to a referent or emotional state, as defined by shared social convention, arbitrary association, or natural relationship (Jenkins, Jimenez-Pabon, Shaw, & Sefer, 1975). While communicating, senders encode their meaning and emotion for the receiver to decode (Buck & VanLear, 2002). Receivers decode and add their interpretation to the intended message and emotion. During transmission from sender to receiver, receivers simultaneously provide feedback to the sender in the form of verbal acknowledgement, gestural reassurance, signs of attention, and facial affect. Likewise, the receiver uses everything a sender says or does during the interaction to infer about the individual's emotional state, personality, thoughts, feelings, or cultural patterns (Wiener et al., 1972). For example, if a sender communicates a pleasant past experience to a receiver, the sender may display empathy by smiling and thus convey their inner emotional state as happy. The receiver infers this emotional state from the smile and may smile or nod in

response to provide gestural reassurance back to the sender. The receiver's reactions and feedback influences the sender's responses in much the same way, with overt behaviors working to influence the entire communicative interaction. The listener is also able to infer and sense the emotions of the sender through nonverbal behaviors such as eye contact, gaze aversion, fluency of speech, or struggle behaviors (Goleman, 2006)

Contrary to reactions to typical speech, when atypical speech is presented to a listener in the form of stuttering or dysarthria, the listener is expected to decode broken and disrupted signals. Stuttered speech presents listeners with atypical auditory disruptions along with visually evident behaviors such as head jerks, lip protrusion, and eye closures (Bloodstein & Bernstein-Ratner, 2008). Dysarthric speech presents listeners with primarily auditory disruptions only, such as a slower speaking rate and slurring (Duffy, 2005). In interpretation of these manifestations of atypical speech, the listener is presented with disruptions to both the communicative intent of the message and the emotional interpretation, causing the listener to experience confusion in their emotional response and subsequently, an altered physiological state (Guntupalli, Everhart, Kalinowski, Nanjundeswaran, & Saltuklaroglu, 2007).

## Stuttered Speech

Stuttering is a speech disorder characterized by both auditory and visual disruptions that affect the sender-receiver dynamic during communication (Bloodstein & Bernstein-Ratner, 2008). Disruptions are often exhibited in the form of auditory blocks, repetitions, and prolongations, along with visually aberrant

behaviors such as head jerking, eye gaze aversion, and facial grimaces (Bloodstein & Bernstein-Ratner, 2008). These overt manifestations of stuttering during communication interactions work to alter the sender-receiver dyad by presenting the receiver with atypical communication behaviors.

## Parkinsonia Dysarthria

Individuals with Parkinsonia Dysarthria typically present with hypokinetic dysarthria. This type of dysarthric speech is mainly characterized by acoustic features of slurring words, speaking with increased effort, and speaking at a slower rate (Duffy, 2005). Further, speakers with Parkinsonia Dysarthria do not show as much of the overt visual behaviors that are seen in stuttering, such as head jerking, eye gaze aversion, and facial grimaces. As stuttering is a disorder that disrupts both auditory and visual modalities of communication, it may be beneficial to compare reactions to speakers of a disorder type that primarily affects the auditory domain only.

# CHAPTER II: LITERATURE REVIEW

## Listener Reactions to Atypical Speech

Receivers' reactions to atypical speech have most widely been studied in reference to people who stutter. Studies have demonstrated that both fluent observers (Guntupalli et al., 2007; Guntupalli, Kalinowski, Nanjundeswaran, Saltuklaroglu, & Everhart, 2006; Guntupalli, Nanjundeswaran, Dayalu, & Kalinowski, 2012) and observers who stutter (Zhang, Kalinowski, Saltuklaroglu, & Hudock, 2010) self-report increased anxiety, uneasiness, and tension when watching people who stutter speak, and exhibit increased physiological arousal in terms of increased average SC and decreased average HR when compared to observing audiovisual stimuli from fluent speakers.

Atypical speech causes a disruption in communication during the encoding process and alters the receiver's reactions. Previous investigations have examined self-reported and biophysiological reactions to stuttering such as negative emotional reactions, increased average SC, and decreased average HR (Guntupalli et al., 2007; Guntupalli et al., 2006; Zhang et al., 2010). When presented with both auditory and visual characteristics that deviate from the normal or expected characteristics of communication, the receiver experiences both physiological arousal and emotional distress. This arousal and distress causes the listener to react with atypical communicative behaviors. For example, when presented with stuttered speech, the listener responds with behaviors such as eye gaze aversion (Bowers, Crawcour, Saltuklaroglu, & Kalinowski, 2009; Hudock et al., 2015; Zhang & Kalinowski, 2012). Furthermore, using self-rating

scales, listeners self-reported more discomfort, sadness, embarrassment, avoidance, unhappiness, arousal, nervousness, and feeling more unpleasant and tense when observing stuttered speech as compared to fluent speech (Guntupalli et al., 2007). Similar reactions have been found in observers of dysarthric speech (Hudock, Altieri, & Seikel, 2013) and in graduate speech-language pathology student clinicians (Guntupalli et al., 2012).

In addition to altering self-reported emotional state and biophysiology in the listener, observing audiovisual recordings of stuttered speech also negatively influences how the listener judges the speaker's personality attributes. Previous studies (Tatchell, Berg, & Lerman, 1983; Von Tiling, 2011) have revealed that listeners hold negative perceptions of a speaker's emotional stability and intelligence when speakers demonstrate stuttered speech. Further compounding this negative judgment is the fact that listeners hold negative stereotypes of people who stutter, believing them to be more emotionally unstable, afraid, tense, nervous, shy, guarded, and sensitive when compared to people who do not stutter (Crawcour, 2010; Cooper & Cooper, 1996; Guntupalli et al., 2006; St. Louis & Lass, 1981; Turnbaugh, Guitar, & Hoffman, 1979; Von Tiling, 2011; Woods & Williams, 1971).

In answering the question, "For graduate speech-language pathology students and graduate counseling students, do physiological reactions to typical and atypical speech before and after participation in an intensive stuttering clinical practicum differ?" the potential effects of such clinics will be better understood. Furthermore, if involvement in these types of clinics proves to be

beneficial in reducing negative reactions to atypical speech, the use of such clinics may have the potential to improve clinician and client relationships. It was hypothesized that there would be a reduction in physiological arousal when observing atypical speech, for graduate speech-language pathology and counseling students after participating in an intensive fluency clinic.

# CHAPTER III: METHODOLOGY

## Participants

Participants consisted of seven speech-language pathology graduate students and six counseling graduate students who participated at the Northwest Center for Fluency Disorders Interprofessional Intensive Stuttering Clinic (NWCFD-IISC). Of the total participants, 12 out of 13 had no previous experience with intensive stuttering clinics. Data was initially analyzed including all 13 participants. However, because one participant had prior participation in an intensive stuttering clinic and closer analysis revealed their data to be an outlier, analysis was conducted excluding that individual. All participants signed an informed consent document (approved by the Idaho State University Human Subjects Committee) prior to experimental conditions (see pg. iv for a representation).

## Instrumentation

Audiovisual stimuli consisted of two speakers who stutter, two speakers with dysarthria, and two fluent speakers verbally reading presented text from a teleprompter as they were recorded with a shoulder-wide focus. Stimuli was presented to participants on an Optiplex 9010 personal computer screen via E-Prime 2.0 stimulus presentation software on a 27-inch widescreen Samsung HDTV model Syncmaster P2770HD monitor. Skin conductance was measured and recorded by BIOPAC Mp150 electrodes adhered to the middle phalanx of the index and middle fingers of the left hand and attached to a remote transducer BIONOMADIX (MODEL BN-TX) (see Appendix A, Figure A1 for a

representation). Heart rate was measured using Electrocardiogram (ECG) information collected from 2 BIOPAC electrodes placed on the right clavicle and one BIOPAC electrode on the left inferior rib (see Appendix A, Figure A2 for a representation). Signals from the channels were synchronized from the output of the E-Prime 2.0 program into the BIOPAC MP 150 system via an STP 100C-C interface module that was visually displayed on Acquknowledge software.

**Stimuli.** Stimuli for the current study were designed similar to that used in Hudock and colleagues (2010). All stimuli speakers were professionally recorded via multimedia staff in sound-treated television studios at either Idaho State University or East Carolina University. Speakers were placed in front of a black background and wore a unidirectional microphone below the viewpoint of the camera. Recordings of speakers were made with a shoulder wide focus to allow for visual inclusion of any secondary stuttering behaviors. Speakers were required to maintain direct eye gaze with the camera and read scripts (Biographies: Skill-Based Story Cards; Remedia, 2006) presented on a teleprompter.

## Procedures

Participants were asked to complete a participant information form (see Appendix B for a representation) to ensure that participants did not have any medical history that could compromise participation or results. Before viewing stimuli, participants were asked to wash and dry their hands thoroughly, ensuring consistent skin hydration levels. Participants sat approximately 24 inches away from the monitor in a comfortable and stationary chair. Alcohol swabs were used

to abrade the middle two phalanges on the left hand to further ensure consistent skin hydration levels. Participants were then asked to abrade and place non-invasive ECG electrodes on the designated areas, using a diagram as a guide to ensure correct placement. Once the electrodes were placed, researchers reiterated the importance that participants did not move, clench their jaw, or talk during the experiment, in order to reduce these movements as much as possible. Physiological measures of skin conductance and heart rate were recorded continuously throughout the entire procedure in order to allow uninterrupted recording before and during exposure to the stimuli. The researcher then started E-Prime 2.0. Participants underwent a 30 second baseline period prior to each stimulus presentation. A randomized video was then presented with either typical or atypical speech. This procedure continued until all videos were presented. Each participant watched each video only one time. Participants underwent similar experimental procedures, directly following the clinic to determine if changes in physiological arousal occurred after prolonged exposure during an interprofessional intensive stuttering clinical practicum.

# CHAPTER IV: RESULTS

## Results

A multivariate analysis was conducted to examine the effect of speaker, speaker category, and time on SC and HR. No significant differences were revealed for SC. A significant difference was revealed for HR in speaker category [$F(5, 55) = 2.411$, $p = 0.048$, $\eta p2 = .180$]. Trends were also revealed for time (pre to post) ($p = 0.101$) and the interaction effect between speaker and time ($p = 0.152$). Pairwise comparisons using least significant difference (LSD) adjustments were carried out to determine the level of difference within the speaker levels. A significant difference was revealed between F1 and D1 ($p = 0.043$). The comparisons also revealed trends between F1 to all other speakers but F2 ($p < 0.01$) and between F2 to D1 ($p = 0.053$). For HR mean pre and post difference values please refer to *Appendix C,* Figure C1 for a representation. Additionally, for a graphical representation of the SC mean difference values, please refer to Appendix C, Figure C2. Lastly, orthogonal single-degree of freedom comparisons were performed to determine differences between speaker groups. Differences were revealed for HR between the pre-clinic for the fluent speaker group to the stuttered group ($p = 0.009$). Please see Table 1 for trends revealed during the comparisons.

Table 1.

| | | |
|---|---|---|
| Pre-clinic Fluent | Pre-Clinic Stuttered | .009 |
| Pre-clinic Fluent | Pre-clinic Dysarthria | 0.161 |
| Pre-clinic Dysarthria | Pre-clinic Stuttered | 0.158 |
| Pre-clinic Fluent | Post-clinic Fluent | 0.052 |
| Pre-clinic Fluent | Post-clinic Dysarthria | 0.129 |
| Pre-clinic Fluent | Post-clinic Stuttered | 0.136 |
| Post-clinic Fluent | Post-clinic Dysarthria | 0.148 |
| Post-clinic Fluent | Post-clinic Stuttered | 0.105 |

*Note: P*-values for single-*df* post-hoc comparisons for *HR* differences

Participants exhibited wider HR and SC variability before the clinic as compared to less variability following the clinic. Participants average heart-rate variability decreased during post assessment. Additionally, a slightly higher positive difference (increased HR) was noted when participants viewed fluent speakers as compared to the combined disfluent categories.

# CHAPTER V: CONCLUSIONS

## Discussion

Contrary to previous research, the current study did not reveal significant differences, or trends toward significance for SC measures. A significant difference was found in HR for speaker category, and trends were revealed for time (pre to post), and interaction effect between speaker and time.

While prior research has revealed participants to have increased physiological arousal through measures of both increased average SC and decreased average HR when watching people who stutter (Guntupalli et al., 2007; Guntupalli et al., 2006; Guntupalli et al., 2012; Zhang et al., 2010), participants in the current study revealed only differences for HR. These findings may be a result of the current study including video stimuli of speakers with dysarthric speech, whereas previous studies compared only fluent speakers and speakers with stuttered speech (Guntupalli et al., 2007; Guntupalli et al., 2006; Guntupalli et al., 2012; Zhang et al., 2010). Another possibility for lack of difference in SC may be due to a difference in time given to measure participants' baseline physiological measures. While previous studies have allowed for a two minute recovery period prior to measuring a 30s baseline (Guntupalli et al., 2007; Guntupalli et al., 2006; Guntupalli et al., 2012; Zhang et al., 2010), the current study did not provide a determined recovery period. Finally, it is possible that the lack of difference in SC is due to the fact that the current study included graduate students who had already completed their first two semesters of graduate education. Previous studies included participants with

no training in the area of speech, language, or hearing disorders (Guntupalli et al., 2007; Guntupalli et al., 2006), students at the undergraduate level who were taking a single graduate level course on fluency (Guntupalli et al., 2012), or were comprised of a combination of undergraduate students, clients, and clinicians (Zhang et al., 2010). The experience, training, and exposure to atypical populations for the speech-language pathology students and the counseling students in the current study may have led to incongruences with SC and HR findings. For the speech language pathology students, increased exposure to and training with populations with atypical speech may have altered their physiological reactions. Similarly, for the counseling students, their training and exposure to populations in which empathy is encouraged may have affected their physiological reactions.

When comparing the mean HR values for pre-clinic, participants had lower HRs when viewing speakers with dysarthric speech and even lower HRs when viewing speakers with stuttered speech. Additionally, a slightly higher positive difference (increased HR) was noted when participants viewed fluent speakers as compared to the combined disfluent categories. Having a lower HR when viewing atypical speech as compared to fluent is consistent with previous research (Guntupalli et al., 2007; Guntupalli et al., 2006; Guntupalli et al., 2012; Zhang et al., 2010), but because the decrease in HR occurs within the current study without an increase in SC, the particular physiological reaction is conflicting. These findings suggest that participants may have been less physiologically aroused, as SC is directly related to arousal (Porges, 1997; Rolls,

2005). The decrease in HR suggests that the participants may have simply been paying more attention to the stimuli of atypical speech or were feeling more uncomfortable, as decreases in HR are associated with negative stimuli and emotional valence (Gomez et al., 2005, Porges, 1997; Rolls, 2005). This may be because participants were anticipating their participation as clinicians in the NWCFD-IISC and were therefore giving more attention to speakers with atypical speech. Furthermore, participants may have felt more sympathy toward speakers with dysarthric speech as indicated by an elevated HR more similar to when viewing normal speakers due to the fact that the speakers with parkinsonian dysarthria appeared more fragile, older, and confused when reading the stimuli prompts as compared to speakers who stuttered. Participants therefore responded with a slightly less decrease in HR, when viewing speakers with Parkinsonia Dysarthria, due to their much older age and more consistent speech errors.

Participants also demonstrated a difference in HR when viewing the first fluent speaker (F1) as compared to when viewing all other speakers except for the second fluent speaker (F2), wherein participants had a higher mean HR when viewing F1. This difference is believed to be a result of participants having some familiarity with F1 as he is a faculty member of the Department of Communication Disorders at ISU. Participants may have felt more comfortable with this particular speaker based on previous interactions and were perhaps paying less attention to the speaker due to lack of novelty. Furthermore, because there was no difference indicated between the two fluent speakers, there is

added support for the idea that participants reacted differently to the speakers based on familiarity, as F2 is also a faculty member in the same department. A significant difference was revealed between F1 and D1 ($p = 0.043$) in which participants had lower HR when viewing the speaker with dysarthria as compared to the fluent speaker. This may be due to the speaker with dysarthria having atypical speech errors and appearing more confused than the fluent speaker. Additionally, based on the conjecture that familiarity is a component in the participants' reactions, D1 is an unfamiliar speaker, causing participants to possibly pay more attention, instigating a lower HR. It is interesting, then that there was no difference found between F2 and D1. This may be due to the second fluent speaker being slightly less natural in their speaking behavior through infrequent eye blinking and a more serious nature, and therefore, more similar reactions to the speaker with dysarthria were produced.

When participants viewed the stimuli post clinic, their HR values were further away from significance. The overall decrease in HR for time may indicate that participants' repeated exposure to the testing situation allowed them to feel more relaxed and more comfortable with the testing situation and the researcher after the clinic. Participants' decrease in HR when viewing fluent stimuli before as compared to after supports this principle. The participants may also have been more comfortable with the speakers and the types of speech in the stimulus videos after having participated in the intensive fluency clinic, therefore paying less attention to the speakers. Additionally, these findings generally support an autonomic decrease in HR when observing atypical speech after the clinic.

However, stuttering stimuli still caused more of a decrease in HR than dysarthric stimuli which may again be due to the participants giving more attention and focus to those particular speakers. The decrease in HR over time is in contradiction to previous studies in which SC attenuated over time, while HR remained stable (Guntupalli et al., 2012; Zhang et al., 2010). The difference may be due to the intensive nature of the fluency clinic. While previous studies found the HR to remain stable within the time frame of a single setting, the current study found the decrease to appear after an intensive fluency clinic. This may indicate that the intensive nature of the clinic, and ability to interact with clients with atypical speech as well as the researcher conducting the study procedure, allowed participants to feel more comfortable. Additionally, two of the speakers presented in the stimuli videos are faculty members within the Department of Communication Disorders at ISU, and participants may therefore have had interactions with the speakers during the intensive fluency clinic, causing their reactions to alter.

## Limitations

Examining facial expression of listeners when watching atypical vs typical speech, examining listeners' self-reported arousal, and examination of listeners' reactions to novel stimulus videos to compare to reactions to previously viewed stimulus videos, were all components of the current study that were ultimately unable to be completed due to experimenter error. It is encouraged that future studies take these components into account to provide for a more comprehensive and accurate examination of sender-receiver dynamics of

atypical speech. Furthermore, it is encouraged that future studies include a higher number of participants to allow for the results to be more representative of the population being studied. The results of the current study should also be taken into consideration with the limits posed by using video stimulus rather than natural face-to-face conversation. The results, therefore, cannot be generalized to natural communication between senders and receivers.

## Conclusion

While differences were found in HR, the current study failed to indicate a difference in SC. Prior to the clinic, participants experienced a suppressed mean HR when viewing speakers with dysarthria, and an even lower HR when viewing speakers with stuttered speech. This supports the idea that listeners are more uncomfortable or were paying more attention when presented with atypical speech as compared to fluent speech.

Participants also reacted differently depending on the particular speaker they were viewing, having a higher HR when viewing the first fluent speaker than any of the other atypical speakers. This may indicate that listeners were most comfortable with that particular fluent speaker than any of the other speakers, including the second fluent speaker. These results indicate that listeners react differently depending on specific speaker characteristics, regardless of whether their speech is atypical or not. Other factors such as eye gaze, age, and familiarity may influence listener reactions.

Trends were revealed between pre and post clinic as HR values were further away from significance after the clinic when compared to before the clinic.

This finding may indicate that participants were more comfortable with the procedure of the study, the environment, and the researcher. Participants may have also been more comfortable with the speakers and the experience of listening to atypical speech.

## Future Research

Future studies should examine a population more naïve to speech and language disorders before and after prolonged exposure to individuals with communication disorders, and should evaluate self-reported cognitive perceptions and stereotypes along with physiological reactions. Future studies should also incorporate listener reactions to new videos in the stimuli set as the current study utilized the same videos in pre and post testing. To understand receivers' portrayal of nonverbal emotion via facial expression during video observations, future studies should incorporate samples of reaction videos (videos of participants faces while watching typical and atypical speech) to be presented to doctoral clinical psychology students for judgment of nonverbal emotions. This would allow researchers to examine receivers' portrayal of nonverbal via facial expressions that can be perceived by the sender. Understanding influences to social acceptance of people who stutter and dynamic communication processes will better enable clinicians to train clients on effective communication, not just difficult to maintain fluency enhancements.

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# Appendix A

## Electrode Placement

**Figure A1: Representation of Skin Conductance Electrode Placement**

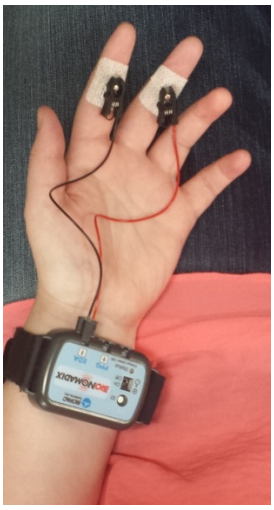
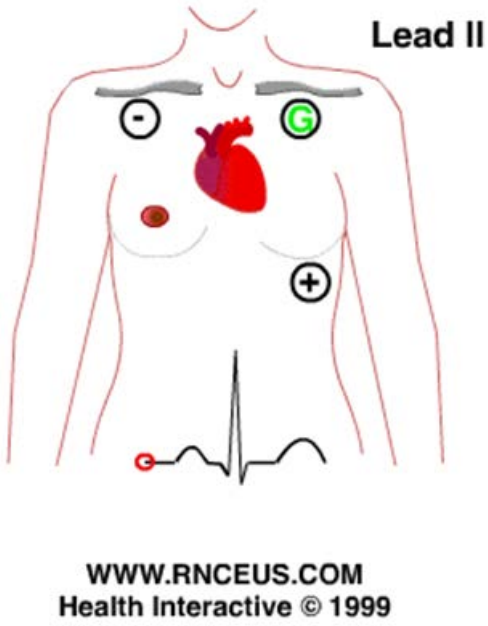


**Figure A2: Representation of Heart Rate Electrode Placement**



# Appendix B

## Participant information form

Participant No. _____ Today's Date and Time: _____/_____/_____
_____ AM PM

Speech Sequence:_____ (Researcher only)

Participant's Name (Initials): ___

Age:___ Gender: M / F Ethnicity:_____

Medical History Questionnaire

Have you ever experienced or been diagnosed with any of the following, or are you experiencing any of the following at present? Please circle the appropriate response and explain any "Yes" answers below.

| | | |
|---|---|---|
| 1. Visual difficulties, blurred vision, or eye disorders | Yes | No |
| 2. Blindness in either eye | Yes | No |
| 3. If Yes to either of the above, have problems been corrected | Yes | No |
| 4. Hearing problems | Yes | No |
| 5. Learning disabilities (problems of reading, writing, or comprehension) | Yes | No |
| 6. Communication disorders | Yes | No |
| 7. Cognitive problems | Yes | No |
| 8. Severe head trauma/injury | Yes | No |
| 5. Stroke | Yes | No |
| 6. Epilepsy or seizures | Yes | No |
| 7. Neurological surgery | Yes | No |
| 8. Paralysis | Yes | No |
| 9. Anxiety disorders | Yes | No |
| 10. Depression | Yes | No |

11. Claustrophobia Yes No

12. Other Neurological, Psychological, or Emotional problems Yes No

Please explain any "Yes" responses:

_____

_____

---

Do you have any family members who have speech/language/hearing/ or neurological deficits?

Yes No

If yes please list the condition: _____

How familiar are you with people who have speech/language/hearing/ or neurological deficits?

Very familiar Not familiar at all

1 2 3 4 5 6 7

# Appendix C

## HR and SC Difference Values by Speaker

**Figure C1 : Heart Rate Difference Values by Speaker**

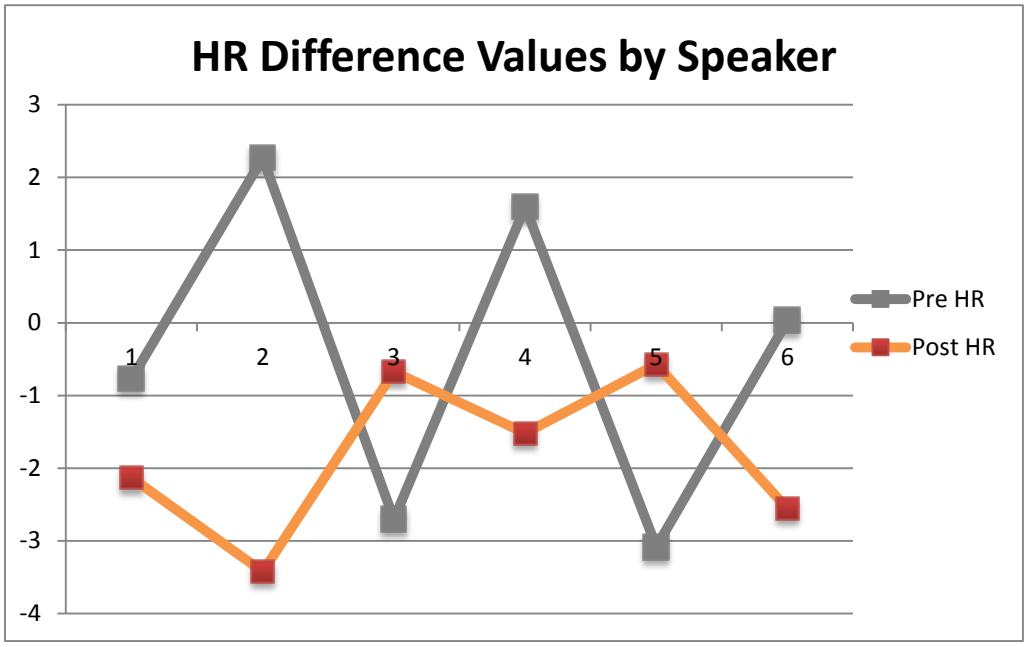
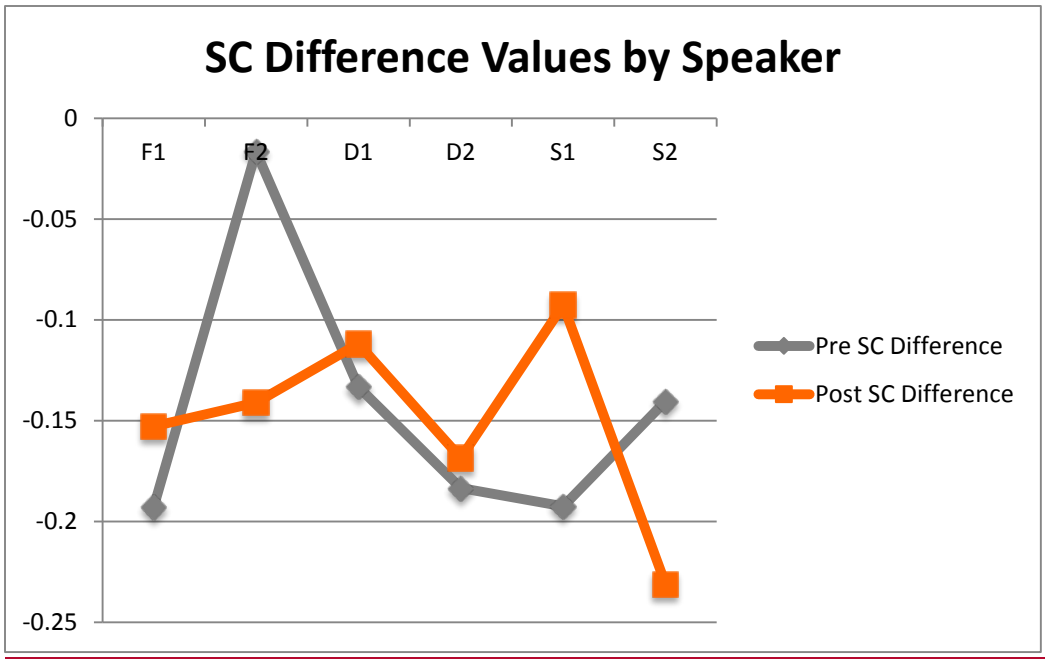


**Figure C2: Skin Conductance Difference Values by Speaker**




**The values in Figure 2 include all 13 participants. Because the difference in SC was found to be non-significant, this information is only presented as an indication of SC results.**