EYE GAZE AND NONVERBAL ASPECTS OF SPEECH IN SOCIAL ANXIETY

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ABSTRACT

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The main concern for people with Social Anxiety Disorder is being negatively evaluated by others. In the current study, 50 undergraduates completed quasi social-emotional evocative tasks which were used to investigate the relationship between social anxiety and real time emotional responses as measured by changes in eye gaze and nonverbal aspects of speech. Repeated measures analyses showed that the valence of interviews had significantly impacted all variables examined. Participants tended to spend less fixation time in the eyes and mouth and a greater percentage of time in silence during intrusive interviews. Significant interactions between social anxiety and interview phase were not revealed with follow-up analyses. Visual inspection of the data suggested more prominent changes in proportion of fixation time and time spent looking off screen for participants higher in social anxiety when responding to intrusive questions. A noted limitation of the current study was the small sample size, which lead to lack of statistical power and difficulty in creating groups using the extremes of the social anxiety score distribution. Although findings provided only partial support for group differences in nonverbal behavior, future research should consider examining these variables using more refined data collection methods and larger sample sizes.

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CHAPTER I

INTRODUCTION

Nonverbal behavior plays an integral role in how information is communicated during human social interactions. By varying body movement, eye gaze, or voice quality, the same content of speech can be communicated/interpreted in many different ways. This follows the old adage, "It's not what you say, but how you say it". The nonverbal flow of information underlies much of human interaction and emotional experience. Given the wealth of information that is routinely displayed, read, and decoded during socio-emotional exchanges, there have been substantial challenges in measuring and interpreting the various sources of information utilized during interactions. However, aspects of vocalization and visual gaze have emerged as key channels of communication (e.g., Adams & Kleck, 2005; Laukka et al., 2008).

At times, nonverbal aspects of speech may be more emotionally informative than the prose. In content-masked speech, when the actual words are filtered out, listeners are able to identify the emotion being expressed relying only on the nonverbal aspects of the speech such as pitch, loudness, and percentage of silence (Laukka et al., 2008). Similarly, eye gaze plays an important role in human social interaction. Direction of eye gaze can influence where others look (e.g. Mansfield, Farroni, & Johnson, 2003), facilitates interpretation of emotion (Adams & Kleck, 2005), communication of dominance or submissiveness, and signals turn-taking in conversation (reviewed in Kleinke, 1986). Nonverbal aspects of speech and eye gaze are learned and intentional and can be brought under executive control. However, there is large body of research supporting the automacitity of higher order complex processes of the kind which govern most social-emotional communication (Bargh, 2000).

Whereas cultural influences are prominent in learning complex processes of social interaction embodied in language and non-verbal display rules (Matsumoto, 2006), individual differences in communication are core to personality expression and personal identity. For example, those high in extraversion are comfortable with a smaller personal space and sustain more eye contact than introverts during social interactions (Mobbs, 1968; Williams, 1971). Not surprisingly, people suffering from social anxiety (diagnostically labeled social phobia) communicate their distress through various non-verbal channels. Social phobics have a marked and persistent fear of being negatively evaluated by unfamiliar individuals in a social and/or performance situation (American Psychiatric Association, 2000). Although research findings have been mixed, people with social anxiety tend to report more physiological arousal during social interaction (Mauss, Wilhelm & Gross, 2004), and make less eye contact than people without social anxiety (Horley, Williams, Gonsalvez & Gordon, 2003) and display a pattern of rapidly shifting eye gaze when determining facial emotions (Horley, Williams, Gonsalvez, & Gordon, 2004). There is evidence that people with social anxiety are perceived as having poor social skills and tend to be rejected by others (Voncken, Alden, Bögels & Roelofs, 2010).

Laukka and colleagues' (2008) were able to link differences in negative emotion from pre- to post-treatment to changes in behavior during speech samples. More specifically, participants who responded to the treatment exhibited greater decreases in average and maximum voice pitch than non-responders as well as in the percentage of the speech spent pausing. There are few studies examining behaviors during social exchange as a function of anxiety. Further research is needed to explore nonverbal behavior across emotionally evocative situations to gain insight into possible differences in reaction and recovery as a function of anxiety. The aim of the current study is to use quasi social-emotional evocative tasks to investigate the relationship

between social anxiety and real time emotional responses as measured by changes in eye gaze and nonverbal aspects of speech.

Emotion Regulation in Social Anxiety

Non verbal aspects of emotional behavior reflect a number of underlying processes. Most obvious among these includes intentional emotional communication (e.g., smiling to communicate pleasure or a non-threatening stance). However, emotion-relevant behaviors are often unintended and may reflect failures of emotional regulation (for example, the quivering voice of the individual speaking to a crowd). Emotion regulation typically occurs on an unconscious automatic level but certain aspects (typically facial displays or vocal tone) can be controlled by conscious effort.

Two broad levels of emotion regulation are *response*-focused (trying to change important features of an emotional response once it has already fully emerged) and *antecedent*-focused (attempting to alter internal or situational variables prior to the expression of an emotion) (Gross, 2002). In suppression (a *response*-focused regulation strategy) the aim is to avoid behavioral manifestations or communication of the emotion. A common example would be learning to keep a 'poker face' as a strategy to mask felt emotion. Conversely, in reappraisal (an *antecedent*-focused regulation strategy) the aim is to change thoughts about a potentially emotionally evocative situation into less emotional or non-emotional terms. For example, a student can think about poor performance on an exam as reflecting the 'unfair' specificity of the test rather than as a reflection of personal worth in order to change the trajectory of the emotional response to exam results.

Individuals with social anxiety experience negative emotions such as fear and anxiety in social situations and frequently utilize suppression over other emotion regulation strategies

(Spokas, Luterek & Heimberg, 2008). Although suppression can be successful in decreasing expressive behavior (such as holding a glass more tightly so as to minimize apparent anxious shaking), it does not appear effective in decreasing the experience of emotion, and may actually increase physiological responses (Gross, 2002). For example, during dyadic exchanges, coached suppression by one partner during emotional communication caused greater physiological arousal in the partner (Butler, Egloff, Wilhelm, Smith, Erickson, & Gross, 2002). Given that suppression mutes behavior, people with social anxiety who utilize this strategy may not participate effectively in the real time give and take of expressive behavior and such disconnection may contribute to others' frustration and discomfort.

Impaired social performance among social phobics may also be linked to reliance on safety behaviors, such as avoiding eye contact and giving either inappropriately short answers or talking too much, which are meant to prevent negative outcomes but more often disturb social interactions and lead to rejection (Clark, 2001). By engaging in safety behaviors, social phobics miss out on the opportunity to support the content of their speech with congruent nonverbal behaviors. For example, if one wants to communicate interest, allowing space for the other(s) to speak, head nodding, and eye contact with the speaker are strong indicators of this sentiment.

Eye Gaze in Social Anxiety

Eye gaze represents a core channel of emotional communication. Information from eye gaze behavior is interpreted in conjunction with other nonverbal cues such as body posture and facial expression to quickly determine an intended message. Typical facial expressions of approach-oriented emotions such as happiness and anger are more quickly identified when paired with a direct gaze while the avoidance-oriented emotions such as sadness and fear are more quickly recognized with an averted gaze (Adams & Kleck, 2003). To the degree that people with

social anxiety avoid eye contact with others in an effort to regulate their emotions, they sacrifice opportunities to communicate and lose access to crucial visual information. During social exchanges, the main focus of attention is usually on the eyes (and mouth), as these regions are the most revealing source of information in the expression of emotion (Lundqvist, Esteves, & Ohman 1999). Eye gaze also has powerful social communication value within exchanges. Higher levels of context appropriate gaze enhances attraction and liking during social introductions (e.g., Stass & Willis 1967), increases perceptions of attentiveness (e.g., Klienke, Bustos, & Pipp, 1975), regulates turn-taking in two-person interactions (e.g., Kendon 1967), and promotes feelings of intimacy (Ellsworth & Poss, 1975). Some evidence suggests that, in general, people make less eye contact when they are asked very personal questions, and that overall, females tend to make more eye contact than males (Exline, Gray, & Schuette, 1965).

Although findings regarding eye gaze behavior in people with social anxiety have been mixed, there is promising evidence to suggest differences in eye gaze behavior between socially and non-socially anxious individuals. Garner, Mogg and Bradley (2006) found that people high in social anxiety spent significantly less time looking at faces (emotional and neutral) than their low socially anxious counterparts. Similarly, Horley, Williams, Gonsalvez, and Gordon (2003) found that people suffering from social anxiety fixated less within the eye region than non-anxious controls, especially when viewing negative (sad) faces (as opposed to neutral and happy faces). Extending the previous study, Horley, Williams, Gonsalvez, and Gordon (2004) found that, in contrast to a control group, socially anxious participants displayed longer scanpaths (i.e., looked around more) and fewer fixations on the eye region when viewing threatening (angry) faces than when viewing nonthreatening (neutral or happy) faces. Additional studies indicate that people with social anxiety engage in less eye contact than people free of social anxiety in

various contexts such as during interviews (Daly, 1978) and while giving speeches (Eves & Marks, 1991).

Other studies have failed to reveal such differences in eye gaze behavior (e.g. Hofmann, Alexander, Gerlach, Wender, & Roth, 1997). Most recently, Wieser, Pauli, Alpers, and Mühlberger (2009) used computer-generated facial expressions to study eye gaze behavior in women with low, medium, and high levels of social anxiety. They found that, although high socially anxious women responded with more pronounced cardiac acceleration, they fixated on the eye region of direct gaze faces *more* than the two lower anxiety groups. This finding may be attributed to the fact that the facial expressions were always neutral, differing only in the direction of eye gaze (averted versus direct). Socially anxious individuals may have made additional effort scanning the neutral faces for subtle facial cues of evaluation. Additionally, participants rated the faces as unrealistic at the conclusion of the experiment suggesting these stimuli may have failed to simulate social interaction.

For people with social anxiety, interacting with unfamiliar others is usually an anxiety provoking situation. Having to respond to an actual person may arouse stronger feelings of anxiety than having to respond to a static picture of a person on the computer screen. Consequently, a number of studies have used cameras positioned behind research confederates during social interactions to later estimate the eye gaze of participants (e.g., Baker & Edelmann, 2002; Biedel, Turner, & Dancu, 1985). In Baker and Edelmann's 2002 study, participants were recorded by a hidden camera while they had a 9-minute conversation with the same female confederate trained to follow the same conversation pattern and display consistent nonverbal behaviors. Videos of participants serving as controls and those diagnosed with social phobia or another anxiety disorder were all scored by the same trained researcher for eye gaze/contact,

along with other behaviors. In this case, the results indicated that participants with social phobia made significantly less eye contact while speaking than those in the other anxious group or participants without a history of psychological disorder. This approach improves external/ecological validity by approximating an authentic social interaction. However, the potential bias of research confederates and the lack of rigorous measurement of eye gaze represents a serious limitation and few of these studies yielded reliable differences associated with social anxiety. The current study is designed to blend the use of ecologically relevant stimuli (videotaped individuals asking questions and pausing for participant answers) with precise measurement of visual exploration in the hopes of modeling the give and take of genuine social exchange without sacrificing laboratory control.

Since eye gaze facilitates effective communication in a number of ways, by avoiding eye contact, people with social anxiety may be placing themselves at a disadvantage in social situations. Avoidant eye gaze may be linked to both communication of anxiety and to emotion regulation (Leary & Kowalski, 1995). That is, others read the non-verbal cue of breaking eye gaze as an indicator of anxiety (depending on the context) and the shift of eye gaze away from the other's face during dyadic exchange deprives the individual of access to the most rich source of socio-emotional data being communicated by his/her partner. Without effective eye contact, people with social anxiety may miss salient emotional information and risk misinterpreting a social situation. A key purpose of the current study is to determine if negative emotional activation causes more socially anxious individuals to display eye gaze avoidance and, if so, will such a pattern persist despite efforts at emotional repair (i.e., videotaped confederate asking pleasantly facilitative questions).

Nonverbal Aspects of Speech

Like eye gaze, nuances of speech transmit a wealth of information. Nonverbal aspects of speech such as volume, rate of talking, and pitch are used to interpret and express affective states (Juslin, & Scherer, 2005). Voice production is influenced by two factors often referred to as push and pull effects (Scherer, 1989). Push effects (the involuntary part of emotional expression) involve physiological processes, such as muscle tension and respiration, which are influenced by emotional state. For example, arousal of the sympathetic nervous system can cause increased muscle tension which influences rate of respiration, facial expression, and shape of the vocal tract (all of which contribute to vocal expression) (Juslin & Scherer, 2005). Conversely, pull effects concern more external influences of vocal expression such as acceptability of various expressions in different cultural or situational contexts. When experiencing a given emotion, people strategically pose emotional expressions for many purposes including self presentation (how one wants to be perceived) and conventionalization (Scherer, 1985). For example, a person with social anxiety may try to mask how nervous he or she is by trying to sound more confident while presenting a project at work.

People use a combination of push and pull effects in everyday social interaction (Scherer, 1989). This makes it difficult to tease apart authentic and posed emotion. Many of the early studies conducted on vocal expression of emotion used posed, rather than authentic expressions of emotion as criteria against which to identify affective expression in target speech samples (e.g. Banse & Scherer, 1996). Posed vocal expression may be more exaggerated and intense than what is encountered in everyday expression (Scherer, 1986). Therefore, it may be more difficult to identify genuine vocal patterns when posed expressions are used as the criteria.

Traditionally, emotions such as happiness, sadness, and anger have received the most research attention in voice analysis while the more targeted study of anxiety is relatively less studied (Juslin & Laukka, 2003). Research findings concerning specific vocal patterns during an anxious state are equivocal. The inconsistency in findings may be due to the varying degrees of anxiety induced in research participants. Analyses of anxious speech utilize data range from mild mood inductions such as having college students prepare to give a speech (e.g., Barrett & Paus, 2002—happy vs. sad) to analysis of pilots' last mayday calls recovered from black boxes (e.g. Kuroda et al., 1976; Williams & Stevens, 1969).

Several paralinguistic aspects of speech have been examined in research on social anxiety. Lewin, McNeil, and Lipson (1996) compared pauses and other verbal dysfluencies (e.g., stuttering and corrections) between people with generalized social anxiety, individuals with circumscribed speech fear, and non-anxious control participants while delivering a short speech on a topic of their own choosing. Pauses were defined as silences within and between sentences lasting two seconds or more. Both clinical groups were found to have a greater number of pauses during the speaking task than the non-anxious group but the length of the pauses were not significantly different between socially anxious and non-anxious groups. Although the mechanisms behind pausing have not been investigated, increased pausing and other speech dysfluencies have been associated with anxious speech (Siegman, 1987).

Laukka and colleagues (2008) analyzed the nonverbal vocal cues of people with social anxiety giving a speech before and after pharmacological anxiolytic treatment. The nonverbal cues examined included fundamental frequency (F0) and the percentage of silence or pauses (% silence) in the speech samples. F0 is most commonly related to auditory perception of voice pitch. When speech is produced, the vocal folds in the throat vibrate to make sound. The

frequency of these vibrations can be averaged over the time of the utterance or speech produced to derive the F0. The more frequent the vibrations are, the higher the perceived pitch. The percentage of silence or pauses (% silence) is the percentage of the total time of the speech that was spent not speaking. Silence is more precisely defined as no speech activity visible on an electronic representation of sound such as an amplitude envelope or spectrogram. During the second speaking task (under the influence of a short acting anti-anxiety medication), people who responded to the treatment showed a reduction in frequency and fewer instances of silence between words from the first speech task. More specifically, there were greater decreases in mean and maximum F0 and % silence in the treatment responders than those who did not respond to treatment (assessed via self-reported anxiety levels). These findings suggest that decreases in anxiety are related to decreases in pauses and voice frequency.

Further exploration of patterns in nonverbal aspects of speech is needed to identify the effects of anxiety on speech production. Clinically, it is intuitive to think of an anxious person under stress as speaking more hesitantly with a higher pitched voice than usual. In the existing literature, pauses have been the most commonly identified variable affected by changes in stress (e.g., Lewin, McNeil, & Lipson, 1996) with additional support for higher voice frequency under stress conditions (e.g., Laukka et al., 2008). In the second portion of Laukka and colleagues' (2008) study, naïve participants who were not involved in the first part of the study listened to content-masked speech samples from people who had and had not responded to treatment for speech anxiety. The content of the speech was obscured by using a filter to remove frequencies over 500 Hertz, making the sample sound muffled and unintelligible. With the actual spoken words obscured, participants rated the speech of non-responders to treatment as sounding more anxious than samples from those who had responded to treatment. These preliminary data

suggest individual differences in vocal parameters such as pitch and pausing are good candidates in the hunt for speech parameters which should covary with activation of social evaluation anxiety.

The Course of Emotional Activation and Anxiety

Although evidence suggests that there are differences in the eye gaze and vocal behavior of socially and non-socially anxious groups, the point in time at which the groups diverge is less clear. Studies on physiological and psychological recovery from fear-related stressors in other anxiety disorders suggest that those in the clinical groups report more distress and take longer to return to baseline levels of physiological measures (e.g., heart rate) than people in the control groups (e.g., Chattopadhyay, Cooke, Toone, & Lader, 1980; Wilhelm, Gerlach, & Roth, 2001). Whereas higher levels of anxiety are reliably associated with slower rates of reported psychological recovery, findings on physiological recovery have been mixed. Mauss, Wilhelm and Gross (2003) found that a high trait social anxiety group reported greater anxiety at the time of a social stressor (i.e., giving a speech) and were slower in recovering to baseline anxiety ratings than the group with low trait social anxiety. However, physiological measures were comparable across the two groups. As eye gaze and nonverbal aspects of speech are affected by both psychological and physiological processes, we hope to observe the effect of social anxiety on these indicators. As in, these behaviors are largely automatic but can be rapidly brought under conscious control in an effort to manage communication in ways that heart rate and sweat responses cannot.

The Current Study

In the current study, we investigated the relationship between level of social anxiety and response to neutral, pleasant, and aversive/intrusive stimuli (videotaped questions). Eye tracking was used to identify where participants looked when listening and responding to videotaped stimuli of a person asking a block of valenced questions. Speech samples from participants' responses to the questions were analyzed to measure patterns in paralinguistic aspects of speech. Neutral questions were used to obtain a baseline of both measures (eye gaze and paralinguistic speech dimensions). Intrusive questions were expected to arouse stress/anxiety, and pleasant valenced questions were presented following the intrusive questions in order to evaluate potential 'carry over' effects of distress patterns versus an expected 'rebound' or normalization of eye gaze and speech qualities in non-anxious individuals. Note that between blocks of interview questions, participants engaged in a facial recognition morphing task (identifying affect displays as quickly as possible). These sets of 60, 2 second morphing trials changed from neutral to an emotion display (angry, happy, disgust, or surprise). Reaction time and accuracy of responses to these trials are central to another study and the stimuli are not intended to evoke emotion. Each morphing set lasted approximately 3 minutes. Below is a graphical representation of the study procedure:

Figure 1. *Timeline for the Study Procedure*

We were interested in examining patterns within and between the three blocks of questions for each participant. We primarily focused on analysis of changes within individual

participants (repeated measures) to maximize power. It was expected that socially anxious individuals would be more reactive to negative and emotionally intrusive questioning and would demonstrate increasing distress in eye movements and speech quality to these probes. Furthermore, we expected that socially anxious individuals would take longer than non-socially anxious individuals to return to baseline patterns of speech and gaze behavior after the emotionally intrusive questions. Specifically, we hypothesized that participants reporting higher levels of social anxiety would demonstrate:

H1: Decreasing periods of time fixating on the eyes and mouth of the interviewer when being asked intrusive questions (Figure 2 for hypothesized effect). As periods of fixation time decrease, we expected the visual scan path to increase (i.e., become longer).

H2: Decreasing duration of fixations within the eye and mouth regions when being asked intrusive questions (Figure 3 for hypothesized effect).

H3: Longer duration of pauses (increasing amounts of time spent pausing) when responding to intrusive questions (Figure 4 for hypothesized effect).

H4: Less normalization of eye gaze fixation/duration in the eyes and mouth when being asked pleasant questions (Figures 2 and 3 for hypothesized effect). That is, avoidance of eye/mouth gaze would persist despite efforts to provide an opportunity of reconciliation/recovery through asking low distress, positive content questions (e.g., “What is something you are especially proud of?”).

H5: Increased time to return to baseline levels of pausing duration when being asked pleasant questions (Figure 4 for hypothesized effect). That is, duration of pausing would remain elevated despite efforts to provide an opportunity for recovery when answering the low distress questions with positive content (e.g., “Describe your warmest family memory.”).

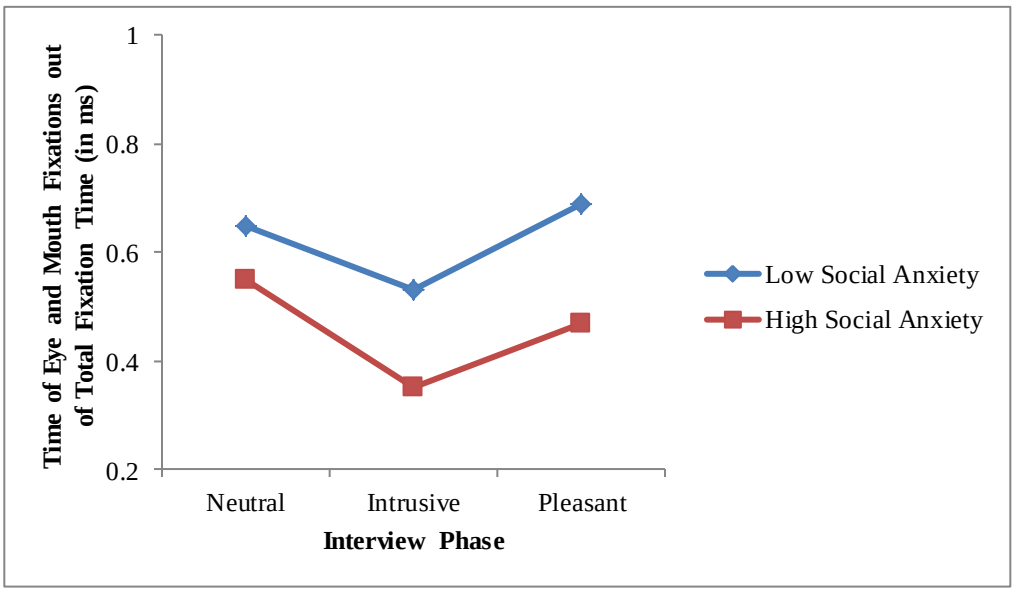

Figure 2. *Time Spent Fixating in the Eyes and Mouth out of Total Fixation Time as a Function of Social Anxiety and Interview Phase*

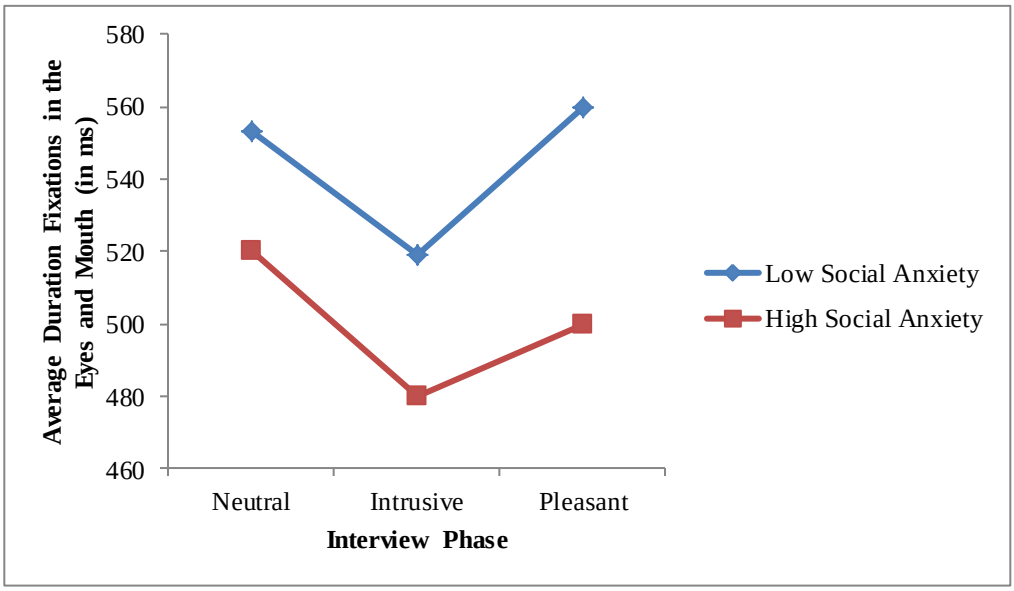

Figure 3. *Average Duration of Fixations in the Eyes and Mouth as a Function of Social Anxiety and Interview Phase*

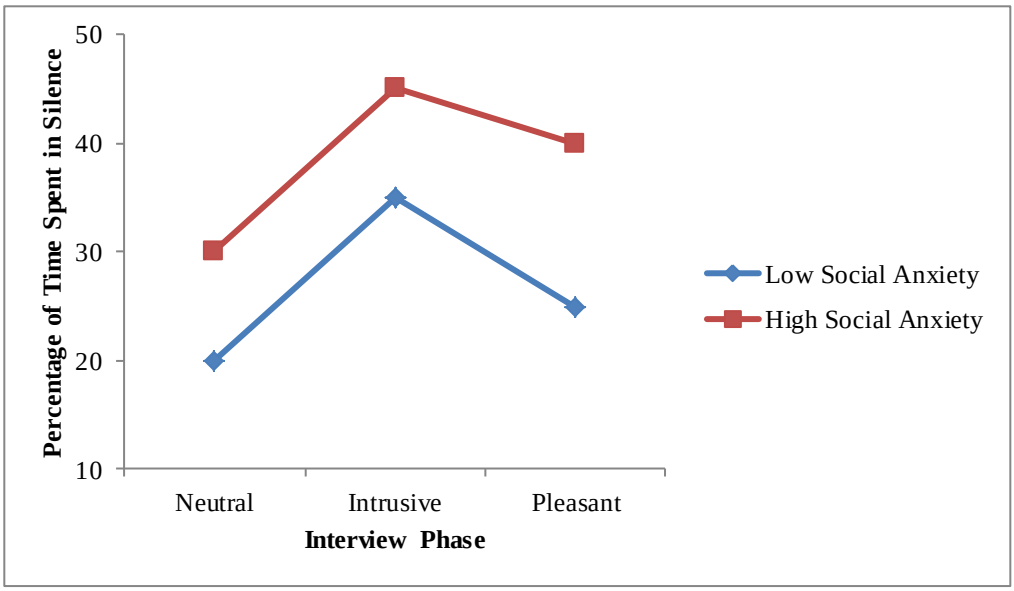

Figure 4. *Duration of Pauses as a Function of Social Anxiety and Interview Phase*

CHAPTER II

METHOD

Participants

Three hundred eighty five undergraduate students enrolled in a psychology course at Central Michigan University (during the 2012 spring semester) were invited to complete the screening measures online and participate in the laboratory research study in exchange for course/extra credit. As a part of the screening measures, students completed the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998), and the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983). All students were recruited for the laboratory portion of the study (across the range of social anxiety). In an effort to oversample from those with higher levels of social anxiety, students who reported the highest scores on the SIAS were recruited individually (through phone calls) whereas other potential participants received an email invite.

Of the undergraduates who completed screener, fifty students were recruited to participate in the study (forty-one women and nine men). The ages of the participants ranged from eighteen to forty-six years (M = 20.76, SD = 5.41). The reported ethnicity of participants was predominantly Caucasian (90%), followed by African-American (4%), Native-American (2%), Asian (2%), and 'Other' (2%). Social anxiety scores of the participants as measured by the SIAS (Mattick & Clark, 1998) and the Brief Fear of Negative Evaluation (BFNE; Leary, 1983) ranged from 0 to sixty (M = 27.35, SD = 16.84) and 1.33 to 5, respectively.

Materials

Questionnaires

There were two phases of the current study, the screening phase, and the laboratory phase. Questionnaires were included as a part of the mass screening completed online by undergraduates currently enrolled in a psychology course at Central Michigan University. The questionnaires included the following measures:

Social Interaction Anxiety Scale

The SIAS is a 19-item self-report scale developed in conjunction with the Social Phobia Scale (SPS) by Mattick and Clark in the 1980s. The SIAS assesses fear of general social interaction. The items are rated on a 5-point scale ranging from "not at all" to "extremely" descriptive of the respondent. Total scores range from 0 to 80, with higher scores indicating greater levels of social interaction anxiety. The SIAS has been found to discriminate between clinical and nonclinical populations, and displays good psychometric properties. The internal consistency of the scale for people with social anxiety is excellent ($\alpha = .93$) as is test-retest reliability over twelve weeks, $r = .92$ (Mattick & Clark, 1998). The SIAS discriminates well among clinical populations, with social anxiety groups scoring higher on the measure than groups with other anxiety disorders including generalized anxiety disorder, panic disorder, and simple phobia (Brown et al., 1997). In addition, the SIAS discriminates well between social anxiety groups, and undergraduate and community samples (Brown et al., 1997). The SIAS has demonstrated good convergent validity with other measures targeting social anxiety such as the SPS ($r = .72$), the Fear of Negative Evaluation Scale (FNES; $r = .66$), the Social Avoidance and Distress Scale ($r = .74$), the social phobia subscale of the Fear Questionnaire (FQ; $r = .66$), and

the Social Phobia and Anxiety Inventory (SPAI; r = .85) (Mattick & Clark, 1998; Peters, 2000). The SIAS was found to correlate moderately with general measures of distress including the State-Trait Anxiety Inventory-Trait (STAI-T; r = .58), the State-Trait Anxiety Inventory-State (STAI-S; r = .45), and the Beck Depression Inventory-Short Form (BDI-S; r = .47) (Mattick & Clark, 1998). In Brown and colleagues' (1997) validation study of the SIAS, a pre-established cut-off score of one standard deviation above the mean of a non-clinical sample (SIAS $\geq$ 34) was used to determine group membership. The measure demonstrated sensitivity of .86, meaning that 86% of social anxiety cases were accurately identified. The measure's demonstrated specificity, or percentage of non-social anxiety cases that were correctly identified, was 70% (Brown et al., 1997).

Social Phobia Scale

The Social Phobia Scale (SPS) is a 20-item measure which assesses anxiety associated with thoughts of being observed and scrutinized by others while engaging in routine activities (e.g., eating, drinking, and writing). The items are rated on a 5-point scale ranging from "not at all" to "extremely" descriptive of the respondent. Total scores range from 0 to 80, with higher scores indicating greater levels of social interaction anxiety. For people with social anxiety, the internal consistency of the scale is good (α = .89) and test-retest reliability over twelve weeks is excellent, r = .93 (Mattick & Clark, 1998). Groups with social anxiety score significantly higher on the SPS than groups with other anxiety disorders, undergraduate samples, and community samples (Brown et al., 1997; Mattick & Clark, 1998). The SPS demonstrated good convergent validity with measures targeting social anxiety such as the FNES (r = .60), the STAI-T (r = .57), the SPAI (r = .72), and the social phobia subscale of the FQ (r = .69) (Mattick & Clark, 1998; Peters, 2000). For people with social anxiety in treatment targeting fears of scrutiny, SPS scores

were significantly lower than initial scores both after treatment and at a 3-month follow-up (Mattick, Peters, & Clarke, 1989).

Brief Fear of Negative Evaluation

In 1983, Leary selected 12 items from the original 30-item FNE (Watson & Friend, 1969) to create the BFNE (Leary, 1983). The BFNE is a brief measure of anxiety associated with thoughts of being negatively evaluated. The 12 self-descriptive statements are rated with 5-point scales ranging from "not at all" to "extremely" characteristic of the respondent. The BFNE demonstrated excellent internal consistency ($\alpha = .90$) and correlated highly with the FNE, $r = .96$ (Leary, 1983). Test-retest reliability was acceptable over four weeks, $r = .75$ (Leary, 1983). The BFNE converges with similar measures of social fear such as the Interaction Anxiousness Scale (IAS; $r = .32$), the anxiety subscale of the Social Avoidance Distress (SAD; $r = .35$), and the social phobia scale of the FQ ($r = .56$) (Collins, Westra, Dozois, & Stewart, 2005; Leary, 1983). In a study comparing people with and without social anxiety, the socially anxious group scored higher on the BFNE than the non-socially anxious group did. After controlling for social anxiety, scores on the BFNE and unrelated measures such as the Anxiety Sensitivity Index (ASI) and the Beck Depression Inventory were not significantly correlated (Weeks, Heimberg, Fresco, Hart, Turk, Schneier, & Liebowitz, 2005). The BFNE was used in hypothesis testing.

State-Trait Anxiety Inventory

The STAI was developed by Speilberger and colleagues (1983) as a self-report measure of anxiety. The STAI consists of two separate scales which each contain 20 self-descriptive items which are rated on a 4-point scale ranging from "almost never" to "almost always". The trait scale (STAI-T) measures anxiety as an enduring trait of the respondent's personality while

the state scale (STAI-S) assesses how anxious a respondent is at the given time. The internal consistency of the state and trait scales is excellent, $\alpha = .90$ and $\alpha = .93$ respectively. In a small group of undergraduates test-retest reliability over 104 days was demonstrated to be high for the trait scale ($r = .75$) and, as expected, lower for the state scale, $r = .33$ (Speilberger et al., 1983). Speilberger and colleagues (1983) reported that the STAI-T was able to discriminate between clinical and non-clinical populations. Participants with disorders featuring anxiety received higher scores than participants with disorders not featuring anxiety. The STAI-S has been shown to detect changes in current anxiety in college students, with examination conditions producing significantly higher scores than a regular class period (Speilberger et al., 1983). The trait scale has been reported to correlate highly with other measures of trait anxiety such as the IPAT Anxiety Scale ($r = .75$), the Zuckerman Affect Adjective Checklist ($r = .52$), and the Taylor Manifest Anxiety Scale ($r = .80$). The trait scale was used to measure how anxious participants are in general (not restricted to social concerns).

Stimulus Material and Equipment

Stimuli

Short videos of one male and two females were recorded with a high quality video camera. Each video began with the actor, maintaining a neutral facial expression and tone, asking a question that was either neutral (e.g., "Tell me about your daily routine"), pleasant (e.g., "Tell me about a time when you felt proud"), or negative (e.g., "Tell me about a time when you felt ashamed"; Appendix A for questions). These questions were followed by a short period in which the actor nodded his or her head expectantly as if listening to the answer. Each video lasted approximately 25 seconds. Questions were administered in blocks (i.e., negative, pleasant, or neutral question groups) and each block used a separate actor.

Eye Tracking

An eye-tracking machine, ISCAN ETL-100, Iscan, Inc., was used to measure the visual exploration of participants while they viewed/responded to the questions. The videos were presented on a 17-inch flat screen computer monitor. Participants sat 24 inches away from the monitor and their visual point of regard was recorded by a remote infrared corneal reflection system (ISCAN PC-464, Iscan, Inc.). This apparatus consisted of a video camera and infrared light source pointed at the participant's left eye. A cheek and forehead rest minimized head movements and ensured a standard distance from the monitor. A research assistant calibrated the eye-tracker to the individual participant and eye movement trials were recorded at 60 Hz with a trial consisting of each question and subsequent answer. The horizontal and vertical points of regard were collected and analyzed offline. Raw eye movement data was cleaned for blinks and other artifacts and reduced into discrete fixations using ILAB, a collection of Matlab functions (Gitelman, 2002). A fixation was defined as a gaze of 167 milliseconds (ms) or longer within a 2-degree visual radius.

Acoustic Measures

Participant responses to the questions asked in the videos were recorded with a digital audio recorder (Olympus VN-4100). Speech analysis was conducted on all of the answers within each question block.

The acoustic voice cues that we examined were fundamental frequency (F0), standard deviation of F0 (F0 SD), and percentage of time in silence (% Silence). All measurements were conducted using PRAAT speech analysis software (Boersma & Weenink, 2007). Before analysis, non-speech sounds such as coughs, clicks of the tongue, and environmental disturbances picked up by the microphone, were removed from the audio files. Each audio

file/speech sample was passed through a filter that defined the upper and lower limits of the frequency to be analyzed. This procedure aids in removing background noise and non-speech sounds. As the range of F0 differs between men and women, a filter of 75 to 300 Hz was set for male speech samples, and a filter of 100 to 600 Hz was set for female speech samples. Afterwards, the mean, and standard deviation of fundamental frequency for each speech sample were extracted using a noise-resistant autocorrelation algorithm which differentiates voiced and unvoiced (silent) segments in speech. In order to evaluate the temporal aspects of speech, the audio samples were observed manually and viewed in a spectrogram for periods of silence. Periods of silence were extracted using PRAAT and converted into a percentage (% Silence).

Morphing Faces Stimuli

For the purposes of an additional study, facial images from the Karolinska Institute's face database were used to create two hundred morphing facial stimuli (Lundqvist, Flykt, & Ohman, 1998). Using FantaMorph software from Abrasoft, morphing videos were created such that each trial begins with a neutral face and morphs into one of four prototypical emotional expressions (i.e., anger, surprise, disgust, or happiness) over a period of one second. Data on participant eye gaze, response latency and accuracy in identifying the emotional expressions was gathered and used in an unrelated study.

Manipulation Checks/Affect Measures

To evaluate the relative success of the unpleasant/intrusive and pleasant questions in affecting mood states, participants completed four ratings of their affective state (at the start of the study and after each block of questions). The Self-Assessment Manikin (SAM; Lang, 1980) was used as a graphic representation of current affect and current arousal ratings. Ratings were

made along a 1000 point continuum from very happy to very unhappy and calm to highly aroused, respectively.

After the data collection phase of the study, participants completed a survey including questions designed to assess how video interviewers were perceived by participants. Participants rated each of the three interviewers on interpersonal traits (e.g., bossy, warm, friendly, and dominant). The descriptors used in the ratings were based off of Leary's (1955) interpersonal circumplex model. We expected that participants' ratings of interviewers would be congruent with the nature of the questions each interviewer asked. If the intrusive questions were aversive, we expected that the interviewer asking those questions would be rated the most negatively (e.g., most bossy and least friendly). Similarly, we expected the interviewer asking pleasant questions to be rated the most positively (e.g., most warm and least bossy).

Procedure

Upon entering the lab, participants were seated in front of the computer monitor and asked to read and sign a copy of the research consent form. Then a hand-held Snellen eye chart was used to ensure corrected vision of at least 20/40. The researcher then briefly outlined the three main parts of the study: identifying emotional faces, responding to interview questions, and rating current levels of mood and arousal.

The participants put on ear cupped headphones, rested their cheeks and forehead in the face rest in front of the computer monitor, and the experimenter used a velcro strap around the back of the head to help secure the position. The experimenter then started the digital vocal recorder and calibrated the eye tracker. After the experimenter was able to successfully monitor each participant's eye movements, the experimental program commenced. The participants were first asked to rate their current affect state on the SAM and provided valence and arousal ratings.

Next, the participants completed 12 practice morphing trials. Then, participants viewed a video of a female (Interviewer 1) introducing the question portion of the study. The participants were then asked to respond to 8 videos of Interviewer 1 posing neutral questions. When respondents provide answers shorter than fifteen seconds, the experimenter triggered a video of Interviewer 1 prompting the participant for a more detailed response. Prompts were randomly selected from a bank of 4 (including, "Tell me more about that", and "What else can you tell me?"). After the neutral question block, participants completed a second valence and arousal rating. Next, participants were shown a series of sixty morphing faces. The participants then viewed a video of another female (Interviewer 2) introducing more questions. The participants were then asked to respond to 8 intrusive questions posed by Interviewer 2. After the intrusive questions, the participants were once again asked to rate their valence and arousal levels and respond to another block of sixty morphing faces. Following this pattern, a male (Interviewer 3) then introduced and asked participants to respond to 8 pleasant questions. The participants were then asked to rate their current valence and arousal levels and respond to a final block of sixty morphing faces. The participants were then unstrapped from the face rest and completed a final survey in which they rated each interviewer in terms of perceived interpersonal style in regards to warmth and dominance. The survey also included the Brief Fear of Negative Evaluation Scale. The experimenter debriefed the participants and assessed for possible distress.

CHAPTER III

RESULTS

In the current study, level of social anxiety was measured using the BFNE (Leary, 1983) and the Social Phobia Scale (Mattick & Clark, 1988). The SPS assesses anxiety associated with thoughts of being observed and scrutinized by others while engaging in routine activities (e.g., eating, drinking, and writing). Similarly, the BNFE is specific to anxiety concerning thoughts of being negatively evaluated. Not surprisingly, the BFNE and SPS were highly correlated, $r = .79$, $p < .001$, consequently, a composite score of these two scales was computed in order to create a more robust indicator of social anxiety level. Scores from both measures were *z*-transformed and summed to create a social anxiety composite score for each participant.

Table 1. *Means and Standard Deviations for Social Anxiety Measures by Social Anxiety Composite Score Groups*

		SIAS		BFNE		Composite SA	
Group	*n*	M	SD	M	SD	M	SD
Low SA	25	17.24	(12.30)	2.38	(.45)	-1.55	(.78)
High SA	24	12.00	(14.39)	3.82	(.49)	1.65	(1.15)
Total	49	27.35	(16.84)	3.07	(.86)	.02	(1.88)

Note: *M* = Mean. *SD* = Standard Deviation. *N* = 49.

Eye behavior and vocal quality data were analyzed using a series of repeated measures analysis of variance (ANOVA) procedures. In these analyses, the repeated measure (within factor) was interview question valence (neutral vs. intrusive vs. pleasant). The composite social anxiety score was used as a continuous variable (through a covariance analysis). Separate high and low social anxiety groups were created for the composite social anxiety score using a median

split. Follow-up analyses were conducted using these high and low social anxiety groups. All violations of the assumption of sphericity in these analyses, as measured by Mauchly's test, were addressed using Greenhouse-Geisser corrections.

Paired samples *t*-tests were conducted to explore the main effects of the repeated measures analyses. As the hypotheses included predictions across all three interview phases, the alpha level for statistical significance was adjusted for the three comparisons using a Bonferroni correction (.05/3 = .017).

Reaction to Emotional Activation Manipulation

In the current study, we employed intrusive and pleasant interview questions to manipulate the affect of participants to mimic the emotional activation which occurs over the course of everyday social interactions. Affect and arousal self-report ratings of participants were collected at four points throughout the experiment. The intrusive interview was intended to increase negative affect and arousal from the baseline levels reported in the neutral interview. The pleasant interview was meant to facilitate recovery to baseline ratings of affect and arousal after the intrusive interview.

Changes in affect and arousal ratings for each participant ($N = 49$) were examined across four time points using repeated measures. Mauchly's test indicated that the affective rating data violated the assumption of sphericity, χ^2 (5) = 13.03, $p < .05$. Consequently, Greenhouse-Geisser corrected degrees of freedom were used to address this violation. There was a significant main effect for time on affect rating, $F(2.50,141) = 5.02$, $p < .01$, $\eta\rho^2 = .10$. The interaction between time and social anxiety was not significant, $F(2.50,141) = .93$, $p = .43$, $\eta\rho^2 = .02$. There was also a significant main effect for social anxiety, $F(1,47) = 10.78$, $p < .01$, $\eta\rho^2 = .19$. In general, participants higher in social anxiety reported less positive affect than participants lower in social

anxiety. In order to examine the main effect of time on affect ratings, we used paired samples *t*-tests to compare ratings at the beginning of the experiment and after the three interview phases (Table 2 for means). The alpha level for statistical significance was adjusted with a Bonferroni correction (.05/4 = .013). Participant affect ratings showed significant increase (more negative affect) from the neutral to intrusive interview phase, $t(49) = -3.36$, $p < .01$. The participant affect ratings became significantly more positive from the intrusive to pleasant interview phase, $t(49) = 2.59$, $p = .01$. Affect ratings after the neutral and pleasant interview phases were not significantly different, $t(49) = -1.01$, $p = .32$, indicating that affect returned to baseline levels after the intrusive interview phase. The intrusive interview phase evoked more negative affect as intended while the pleasant interview phase served to facilitate more positive affect.

Table 2. *Participant Affect Ratings by Measurement Period*

		Baseline		Post Neutral		Post Intrusive		Post Pleasant	
Group	*n*	M	SD	M	SD	M	SD	M	SD
Low SA	25	289.40	(103.05)	272.96	(105.27)	331.28	(105.72)	280.72	(115.44)
High SA	24	324.29	(133.32)	332.79	(123.06)	390.00	(130.16)	354.00	(113.97)
Total	49	306.49	(118.90)	302.27	(117.09)	360.04	(120.77)	316.61	(119.41)

Note: Lower affect scores reflect more positive affect. *M* = Mean. *SD* = Standard Deviation. *N* = 49.

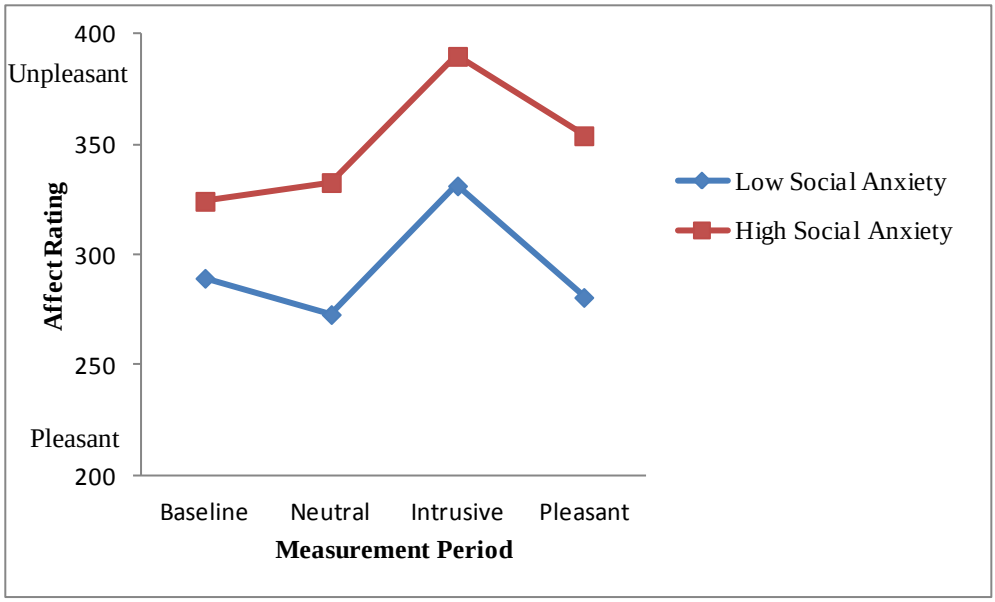

Figure 5. *Participant Affect Ratings Across Measurement Period*

Next, the arousal ratings across the four time points were examined. Mauchly's test indicated that the arousal rating data violated the assumption of sphericity, χ^2 (5) = 26.58, p < .01. There was a significant main effect for time on arousal rating, F(2.26,141) = 10.08, p < .01, $\eta\rho^2$ = .18. There was not a significant interaction between time and arousal rating, F(2.26,141) = .86, p = .44, $\eta\rho^2$ = .02. There was a significant main effect for social anxiety on arousal rating, F(1,47) = 4.32, p < .05, $\eta\rho^2$ = .08. In general, participants higher in social anxiety reported feeling more worked up than participants lower in social anxiety.

In order to examine the main effect of time on arousal ratings, paired samples *t*-tests were used to compare ratings at the beginning of the experiment and after the three interview phases (Table 3 for means). Participant arousal ratings showed significant decrease (more worked up) from the neutral to intrusive interview phase, t(49) = 3.67, p < .01. Arousal ratings showed that participants became significantly more calm from the intrusive to pleasant interview phase, t(49) = -3.64, p < .01. Arousal ratings after the neutral and pleasant interview phases were not

significantly different, $t(49) = .45$, $p = .65$, indicating that arousal returned to baseline levels after the intrusive interview phase. The intrusive interview phase evoked a more agitated (worked up) state as intended while the pleasant interview phase served to facilitate more feelings of calm.

Table 3. *Participant Arousal Ratings by Measurement Period*

		Baseline		Post Neutral		Post Intrusive		Post Pleasant	
Group	*n*	M	SD	M	SD	M	SD	M	SD
Low SA	25	545.68	(161.58)	491.96	(165.76)	436.32	(136.03)	479.08	(153.32)
High SA	24	442.13	(157.82)	418.83	(168.01)	332.96	(102.86)	419.33	(134.37)
Total	49	449.82	(166.51)	456.14	(169.20)	385.69	(130.57)	449.82	(146.00)

Note: Lower arousal scores reflect higher arousal. *M* = Mean. *SD* = Standard Deviation. *N* = 49.

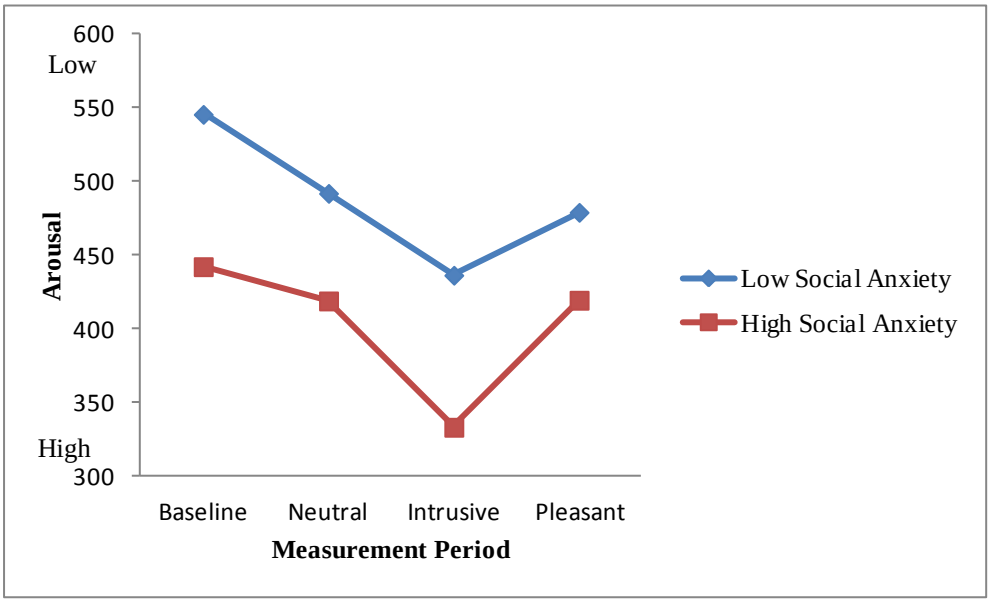

Figure 6. *Emotional Arousal Across Measurement Period*

Interpersonal Ratings for Interviewers

Participant ratings of perceived interpersonal traits (e.g., bossy, friendly, and helpful) for each of the three interviewers were also used as an affect manipulation test. We expected that participants' ratings of interviewers would be congruent with the nature of the questions each

interviewer asked. If the intrusive questions were aversive, we expected that the interviewer asking those questions would be rated the most negatively (e.g., most bossy and least friendly). Similarly, we expected the interviewer asking pleasant questions to be rated the most positively (e.g. most friendly and least bossy).

Participants' ratings (N = 50) of bossiness and friendliness for each of the three interviewers were examined using repeated measures. There was a significant main effect for interviewer on bossiness rating, $F(2,98) = 3.91$, $p < .05$, $\eta\rho^2 = .07$. In order to examine this main effect, we used paired samples t-tests to compare bossiness ratings for the three interviewers. The alpha level for statistical significance was adjusted with a Bonferroni correction (.05/3 = .017). The intrusive question interviewer was rated as significantly more bossy, $M = 3.02$, $SD = 1.95$, than the pleasant question interviewer, $M = 2.32$, $SD = 1.58$, $t(49) = 2.69$, $p = .01$. Although the mean rating for the intrusive interviewer was higher than that of the neutral interviewer, $M = 2.78$, $SD = 1.67$, this difference did not reach statistical significance, $t(49) = -.24$, $p = .35$. These results showed partial support for the expectation that the intrusive interviewer would be perceived as the most bossy interviewer given the valence of the questions asked.

Next, the participants' ratings for interviewer friendliness were examined. There was not a significant main effect for interviewer on friendliness rating, $F(2,98) = .67$, $p = .51$, $\eta\rho^2 = .02$. Similar non-significant outcomes were found for the effects of interviewer on participant ratings of other positive interpersonal traits (e.g., cooperativeness, helpfulness, and supportiveness). Although the affect manipulation was successful, participant ratings for interviewer traits did not seem to be strongly impacted by the valence of the questions asked.

Testing Hypotheses

In order to evaluate the hypotheses regarding the number and duration of eye fixations on the eyes and mouth, the analyses were separated into two parts: fixations on the eyes and mouth while the interviewers asked the questions (i.e., early phase; lasting 3 seconds), and fixations on the eyes and mouth while the participants provided responses (i.e., late phase; of varied duration). This evinced a more precise/nuanced evaluation of eye gaze behavior during these different aspects of social interaction. Of the 50 students who took part in the study, 33 had sufficient data to be included in the eye behavior analyses. Data loss was attributed to poor eye tracker calibration by the experimenters.

Average Durations of Fixations in the Eyes and Mouth Across Interview Phases

We hypothesized that participants higher in social anxiety would demonstrate decreased fixation time in the eyes and mouth during the intrusive interview phase, and take longer to return to baseline levels of fixation time in the eyes and mouth during the pleasant interview phase. In order to test these hypotheses, we calculated the average time per fixation in the eyes and mouth for each participant by dividing the total duration of fixations in the eyes and mouth by the total number of fixations in the eyes and mouth. The average duration of fixations in the eyes and mouth for each interview phase (neutral, intrusive, and pleasant) was used for the repeated measures analyses.

We examined the early phase eye movement data first. There was not a significant main effect for interview phase on average duration of fixations in the eyes and mouth, $F(2,62) = 1.92$, $p = .155$, $\eta\rho^2 = .06$. The interaction between interview phase and composite social anxiety was not statistically significant, $F(2,62) = .86$ $p = .43$, $\eta\rho^2 = .03$. The main effect for social anxiety on average fixation duration in the eyes and mouth also failed to reach significance in the early

phase, $F(1,31) = .19$, $p = .67$, $\eta\rho^2 = .01$. Although these results were not significant, there may have been differences between participants higher and lower in social anxiety not revealed due to lack of statistical power (Table 4 and Figure 7). Visual inspection of Figure 7 suggested that the mean duration of fixations in the eyes and mouth actually increased over time for the high social anxiety group while the low social anxiety group maintained similar fixation durations in the eyes and mouth across interview phases. Contrary to our hypotheses, participants higher in social anxiety appeared to have the shortest fixation durations in the eyes and mouth during the neutral interview phase.

Table 4. *Average Duration of Fixations in the Face for Social Anxiety Composite Score Groups During Early Periods of the Interview Phases*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA	16	500.64	(180.44)	505.50	(152.76)	514.14	(158.01)
High SA	17	463.82	(144.38)	480.84	(123.53)	508.54	(172.64)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 33.

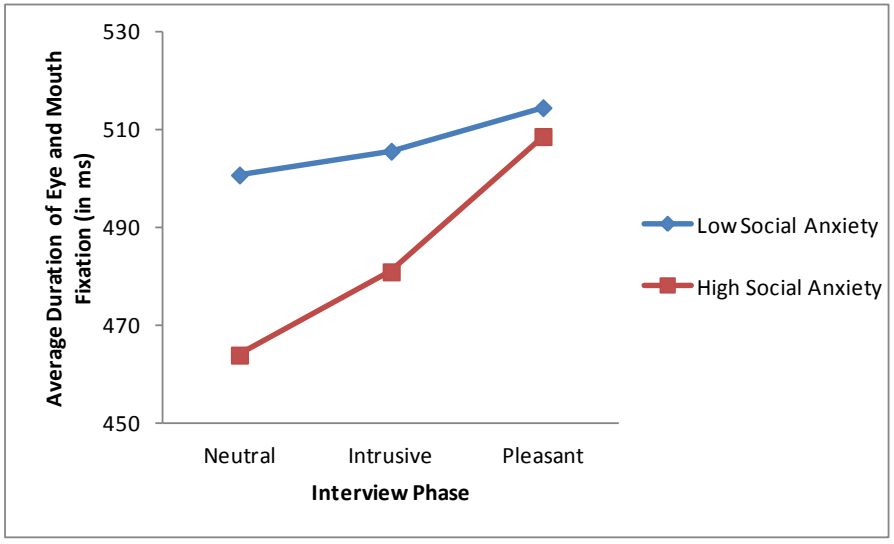

Figure 7. *Average Duration of Fixations in the Eyes and Mouth in the Early Phase as a Function of Interview Phase and Social Anxiety Group Membership*

Next, we examined the average duration of fixations in the eyes and mouth during responses (late question period) in the interview phases. Mauchly's test indicated that the data violated the assumption of sphericity, χ^2 (2) = 12.55, $p < .05$. There was not a significant main effect for interview phase on average duration of fixations in the face, $F(1.49,30) = 2.05$, $p = .15$, $\eta\rho^2 = .06$. The interaction between interview phase and composite social anxiety was not statistically significant, $F(1.49,30) = .73$ $p = .45$, $\eta\rho^2 = .02$. The main effect for composite social anxiety on average fixation duration in the face also failed to reach significance in the late question period, $F(1,31) = .29$, $p = .59$, $\eta\rho^2 = .01$. Similar to findings in the early phase, visual inspection of Table 5 and Figure 8 did not support our hypotheses, suggesting that the shortest fixation durations in the eyes and mouth were during participant responses in the neutral interview phase.

Table 5. *Average Duration of Fixations in the Eyes and Mouth for Social Anxiety Composite Score Groups During Late Question Periods of Interview Phases*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA	16	558.03	(178.44)	566.12	(165.71)	654.40	(317.51)
High SA	17	596.66	(192.89)	670.34	(250.00)	647.12	(312.41)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 33.

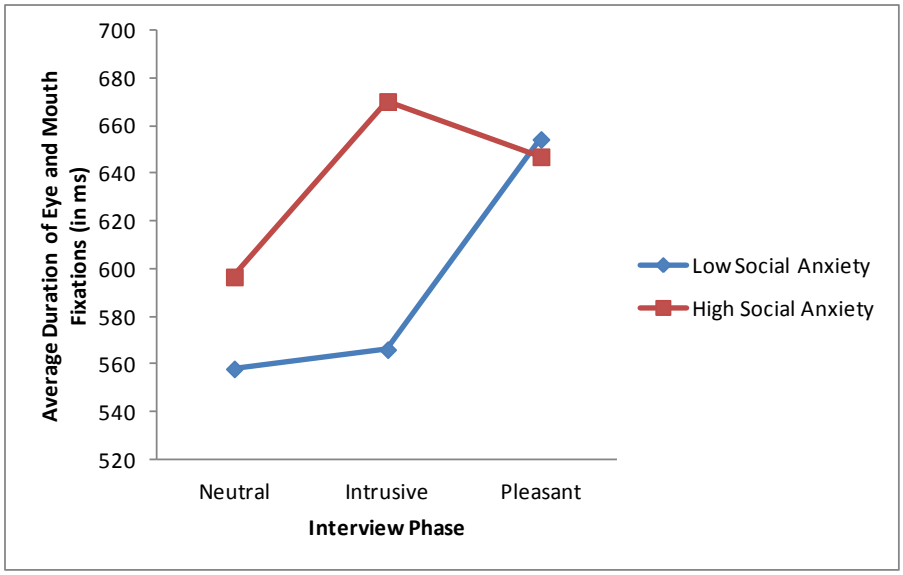

Figure 8. *Average Duration of Fixations in the Eyes and Mouth as a Function of Late Question Periods of Interview Phases and Social Anxiety Group Membership*

Time Spent Looking at the Eyes and Mouth Relative to Total Viewing Time

Additional analyses were conducted to evaluate the hypotheses concerning the amount of time spent fixating in the eyes and mouth relative to total fixation time across interview phase. We hypothesized that those higher in social anxiety would show decreasing periods of time fixating in the eyes and mouth of the interviewer during the intrusive interview phase. In addition, we hypothesized that greater social anxiety would be associated with slower subsequent recovery to baseline levels of time spent fixating in the eyes and mouth.

The eye movement data from the early question period of the interviews (the first 3 seconds of each trial while the interviewer was asking questions) was examined in three ways: (1) a count of the number of fixations in the eyes and mouth per second during the early question periods was calculated, (2) a ratio was calculated to reflect the number of fixations within the eyes and mouth region as a function of total fixations and (3) fixation time spent fixating in the eyes and mouth of the interviewer relative to total fixation time. The duration of questions

ranged from 2.1 seconds to 4.5 seconds in length (M = 3.34, SD = .56). A value of 3 seconds was used as the duration of interview questions to facilitate analyses and interpretation. As participant response times were not uniform in duration (that is, verbal responses were varied in length), the time bound variables could not be computed for the response period. Instead, other variables such as time spent looking off-screen and average fixation duration were examined during the response period.

Since the early question periods were uniform in duration (i.e., 3 seconds), the number of fixations in these periods were divided by 3 to obtain a count of the number of fixations in the eyes and mouth per second. There was a significant main effect for interview phase on average number of fixations within eyes and mouth per second during the early question period, $F(2,62) = 8.27$, $p < .01$, $\eta\rho^2 = .21$. The interaction between interview phase and composite social anxiety failed to reach significance, $F(2,62) = 2.40$, $p = .10$, $\eta\rho^2 = .07$. There was not a significant main effect for composite social anxiety on average number of fixations in the eyes and mouth per second, $F(1,31) = .02$, $p = .89$, $\eta\rho^2 = .00$.

Follow-up analyses were conducted to examine the main effect for interview phase on number of fixations within the eyes and mouth per second in the early question period. The alpha level for statistical significance was adjusted with a Bonferroni correction (.05/3 = .017). Participants made significantly fewer fixations within the eyes and mouth per second in the intrusive interview phase, M = 1.52, SD = .49, than in the neutral interview phase, M = 1.76, SD = .48, $t(32) = 4.08$, $p < .01$. The difference in the number of fixations in the eyes and mouth per second in the neutral interview phase (M = 1.76, SD = .48) and pleasant interview phase (M = 1.59, SD = .49) failed to reach significance, $t(32) = 2.46$, $p = .02$. There was a not significant difference in the number of fixations in the eyes and mouth per second in the intrusive interview

phase (*M* = 1.52, *SD* = .49) and pleasant interview phase (*M* = 1.59, *SD* = .49), *t*(32) = -1.28, *p* = .21. Participants made a similar number of fixations per second in the pleasant and intrusive interview phases.

Although the interaction between social anxiety and early question periods of interview phases did not reach significance, the obtained effect size ($\eta\rho^2$ = .07) suggested that more power would be needed to reveal significant results. Visual exploration of the data (Table 6 and Figure 9) suggested the presence of a crossover interaction. Participants lower in social anxiety demonstrated a similar number of fixations in the eye and mouth region per second in the intrusive and pleasant interview phases while the participants higher in social anxiety showed an increase in fixations per second during the pleasant interview phase to surpass the low social anxiety participants.

Table 6. *Average Number of Fixations in the Eyes and Mouth per Second for Social Anxiety Composite Score Groups During Early Question Periods of Interview Phases*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA	16	1.84	(.41)	1.58	(.51)	1.57	(.46)
High SA	17	1.68	(.53)	1.47	(.47)	1.62	(.54)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 33.

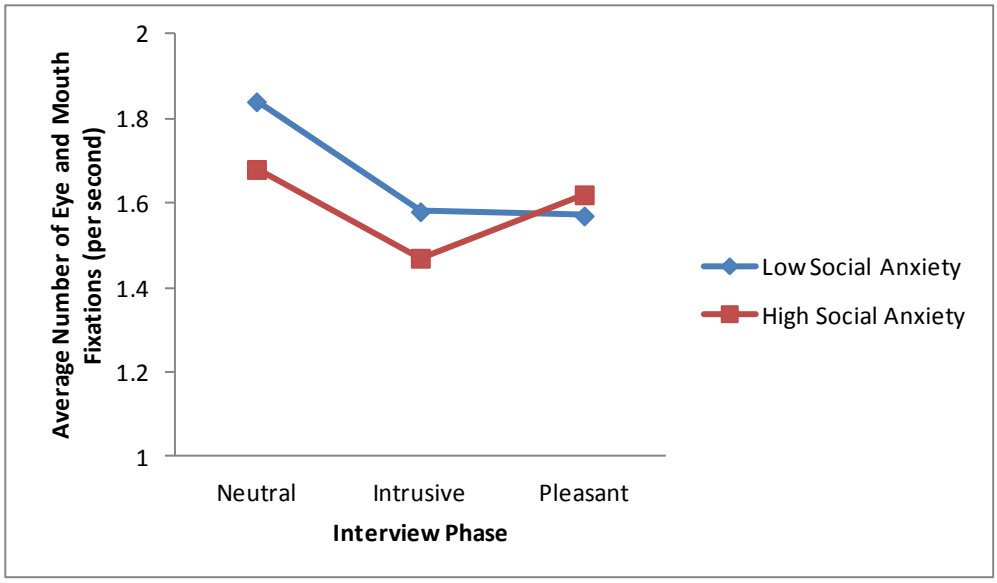

Figure 9. *Average Number of Fixations in the Eyes and Mouth per Second as a Function of Social Anxiety and Early Question Periods of Interview Phases*

Next, a ratio was computed to examine the amount of total fixation time that was spent fixating in the eyes and mouth during the early question period. There was a significant main effect for interview phase on the proportion of fixation time spent in eyes and mouth, $F(2,62) = 5.40$, $p < .01$, $\eta\rho^2 = .15$. The interaction between interview phase and composite social anxiety was also statistically significant, $F(2,62) = 4.95$ $p < .05$, $\eta\rho^2 = .14$, indicating that the proportion of fixation time spent in the eyes and mouth differed depending on both interview phase and composite social anxiety score. The main effect for social anxiety on e proportion of fixation time spent in the eyes and mouth failed to reach significance in the early question period, $F(1,31) = .00$, $p = .96$, $\eta\rho^2 = .00$ (Table 7 and Figure 10).

Follow-up analyses included paired samples *t*-tests to examine the main effect for interview phase on proportion of fixation time spent in the eyes and mouth in the early question period. Participants spent a significantly smaller proportion of fixation time in the eyes and mouth in the intrusive interview phase, $M = .82$, $SD = .19$, than in the neutral interview phase,

M = .90, *SD* = .13, *t*(32) = 3.06, *p* < .01. The difference in the proportion of fixation time spent in the eyes and mouth during the neutral interview phase, *M* = .90, *SD* = .13, and pleasant interview phase, *M* = .88, *SD* = .14, was not significant, *t*(32) = .75, *p* = .46. The difference in the proportion of fixation time spent in the eyes and mouth during the intrusive interview phase, *M* = .82, *SD* = .19, and pleasant interview phase, *M* = .88, *SD* = .14, failed to reach statistical significance, *t*(32) = -2.32, *p* = .03. Participants appeared to spend the least time looking in the eyes and mouth, relative to total time spent looking, during the intrusive interviews which is consistent with general expectations of attentional avoidance during distressing activation.

Paired samples *t*-tests were conducted separately for the high (*n* = 17) and low (*n* = 16) social anxiety groups to explore the interaction as a function of social anxiety. These group level paired samples *t*-tests did not reveal the interaction obtained in omnibus testing (largest for high social anxiety group, *t*(16) = -2.50; largest for low social anxiety group, *t*(15) = 2.37). Further analyses were conducted in the form of independent samples *t*-tests. Difference scores between interview phases were computed for each group to get at whether the difference between the difference scores of the two groups would reveal the interaction effect. However, these analyses also failed to obtain statistically significant result (largest difference, *t*(31) = 2.50). Visual inspection of Table 7 and Figure 10 suggested that participants higher in social anxiety were more successful at recovering to baseline proportions of fixation time in the eyes and mouth than the participants lower in social anxiety. Participants higher in social anxiety appeared to show the lowest proportion of fixation time in the eyes and mouth during the intrusive interview phase.

Table 7. *Proportion of Time Spent Fixating in the Eyes and Mouth out of Total Fixation Time for Social Anxiety Composite Score Groups During Early Interview Phases*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA	16	.95	(.07)	.85	(.19)	.86	(.17)
High SA	17	.86	(.15)	.80	(.19)	.90	(.11)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 33.

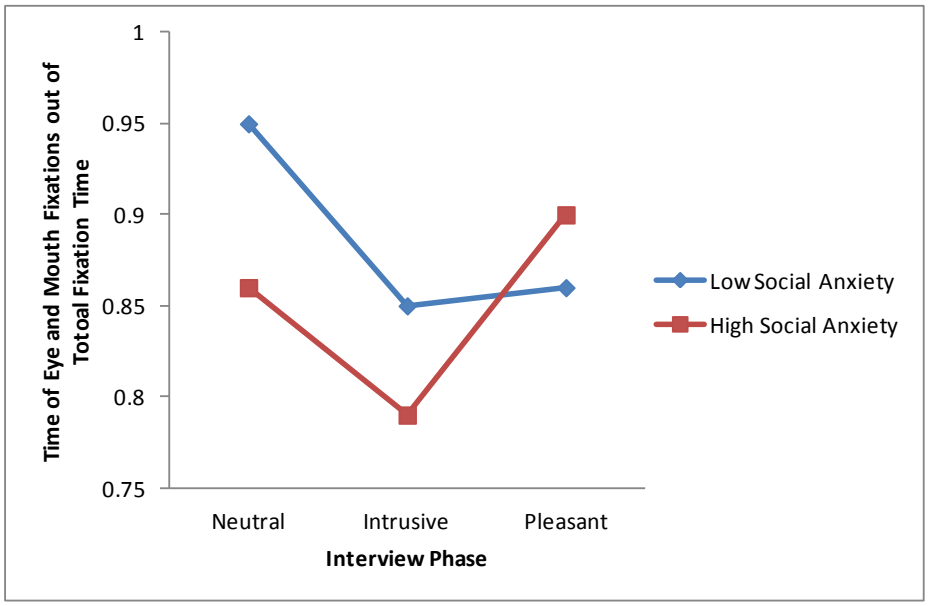

Figure 10. *Proportion of Time Spent Fixating in the Eyes and Mouth out of Total Fixation Time Ratio Across Early Interview Phase as a Function on Social Anxiety*

A ratio was computed to examine the amount of total fixation time that was spent in the eyes and mouth during the late question periods (while participants responded to questions). We expected that participants with greater social anxiety would spend a smaller proportion of time fixating in the eyes and mouth during the intrusive interview phase and demonstrate difficulty rebounding to the proportion of fixation time spent in the eyes and mouth during the neutral interview phase. Mauchly's test indicated that the data violated the assumption of sphericity, χ^2 (2) = 12.55, $p < .05$. There was a significant main effect for interview phase for the proportion

of time spent fixating in the face region while responding to questions, $F(1.45,62) = 5.28$, $p < .01$, $\eta\rho^2 = .15$. However, the interaction between interview phase and composite social anxiety was not statistically significant, $F(2,30) = .12$ $p = .88$, $\eta\rho^2 = .01$. The main effect for social anxiety on the proportion of time spent fixating in the eyes and mouth failed to reach significance in the late phase, $F(1,31) = .05$, $p = .83$, $\eta\rho^2 = .00$.

Follow-up analyses included paired samples *t*-tests to examine the main effect for interview phase on proportion of time spent fixating in the eyes and mouth in the late question period. Participants spent a significantly smaller proportion of time spent fixating in the eyes and mouth in the intrusive interview phase, $M = .52$, $SD = .21$, than in the neutral interview phase, $M = .62$, $SD = .19$, $t(32) = 3.48$, $p < .01$. The difference in proportion of time spent fixating in the eyes and mouth during the neutral interview phase, $M = .62$, $SD = .19$, and pleasant interview phase, $M = .56$, $SD = .24$, was not significant, $t(32) = 1.47$, $p = .15$. The difference in proportion of time spent fixating in the eyes and mouth during the intrusive interview phase, $M = .52$, $SD = .21$, and pleasant interview phase, $M = .56$, $SD = .24$, failed to reach significance, $t(32) = -1.99$, $p = .06$. Visual inspection of Table 8 and Figure 11 showed that participants higher in social anxiety appeared to spend the lowest proportion of fixation time in the eyes and mouth during the intrusive interview phase and a slow recovery to baseline proportions of fixation time spent in the eyes and mouth established in the neutral interview phase.

Table 8. *Proportion of Time Spent Fixating in the Eyes and Mouth out of Total Fixation Time for Social Anxiety Composite Score Groups During Late Question Periods of Interview Phases*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA	16	.66	(.18)	.54	(.23)	.60	(.25)
High SA	17	.59	(.20)	.50	(.20)	.53	(.23)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 33.

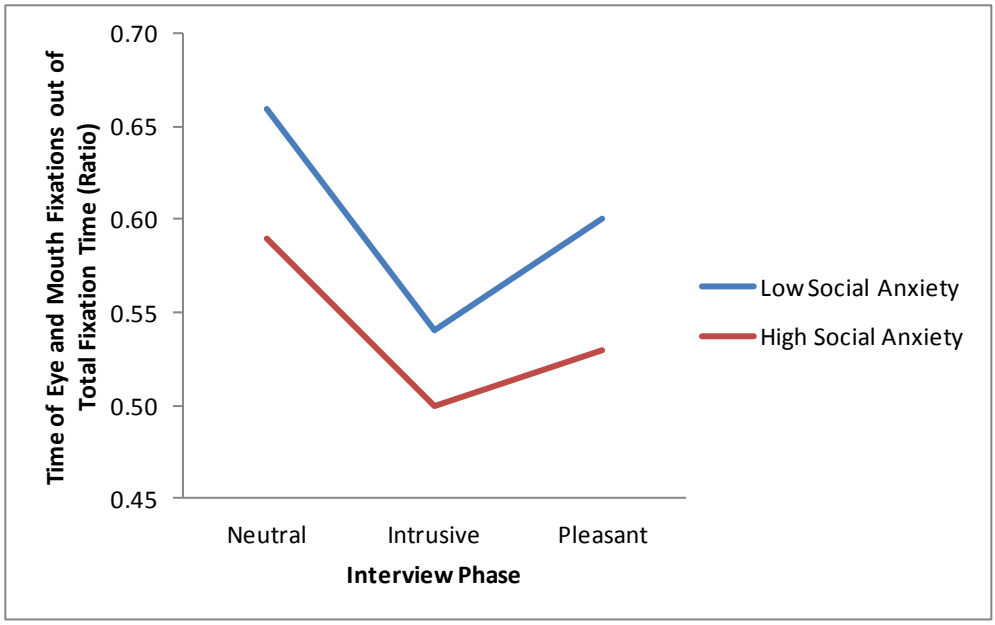

Figure 11. *Proportion of Time Spent Fixating in the Eyes and Mouth out of Total Fixation Time Percentage Across Late Question Periods of Interview Phase as a Function of Social Anxiety*

Interpretation of Percent Zero Values for Eye Movement Data.

Eye movement data for each participant included number of fixations, fixation time, and percentage of missing data. Missing data includes windows of time during which the eye tracker loses the two measurements it needs to calculate point of visual regard. These are the pupil center and the corneal reflection. This happens when (1) the participant closes (or nearly closes) his or her eyes as in a blink, or (2) when the participant looks off screen far enough that the camera cannot track these eye characteristics. In order to examine whether the percentage of missing data was due to technical data collection problems (typically caused by poor calibration—and hence representing error rather than looking off screen), the percentage of missing data from the early phase of each question was subtracted from the percentage of missing data from the late phase of each question. Calibration error should be constant for each participant within trials so the percent of missing data points should not vary as a function of

mechanical issues but rather as a function of visual behavior of the participant. That is, positive difference scores should reflect time spent looking off of the screen.

There was a significant main effect for interview phase on time spent looking off of the screen while responding to questions, $F(2,62) = 7.52$, $p < .01$, $\eta\rho^2 = .20$. The interaction between interview phase and composite social anxiety was not statistically significant, $F(2,62) = .96$ $p = .39$, $\eta\rho^2 = .03$. The main effect for social anxiety on time spent looking off screen failed to reach significance in the late phase, $F(1,31) = .45$, $p = .51$, $\eta\rho^2 = .01$. Participants spent significantly more time looking off screen in the intrusive interview phase, $M = 33.41$, $SD = 19.03$, than in the neutral interview phase, $M = 26.34$, $SD = 18.64$, $t(32) = -4.38$, $p < .01$. The difference in time spent looking off of the screen during the neutral interview phase, $M = 26.34$, $SD = 18.64$, and pleasant interview phase, $M = 30.40$, $SD = 19.63$, was not significant, $t(32) = -1.93$, $p = .06$. The difference in time spent looking off screen during the intrusive interview phase, $M = 33.41$, $SD = 19.03$, and pleasant interview phase, $M = 30.40$, $SD = 19.63$, failed to reach significance, $t(32) = 1.70$, $p = .10$.

Although the interaction between social anxiety and interview phase was not statistically significant, visual examination of Table 9 and Figure 12 suggested a crossover interaction. Participants higher in social anxiety showed a more dramatic (albeit non-significant) increase in time spent looking off screen than participants lower in social anxiety during the intrusive interview phase.

Table 9. *Percentage of Time Spent Looking Off-screen for Social Anxiety Composite Score Groups During Late Question Periods of Interview Phases*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA	16	26.80	(19.50)	31.62	(16.21)	30.87	(20.83)
High SA	17	25.91	(18.48)	35.10	(21.71)	29.95	(19.07)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 33.

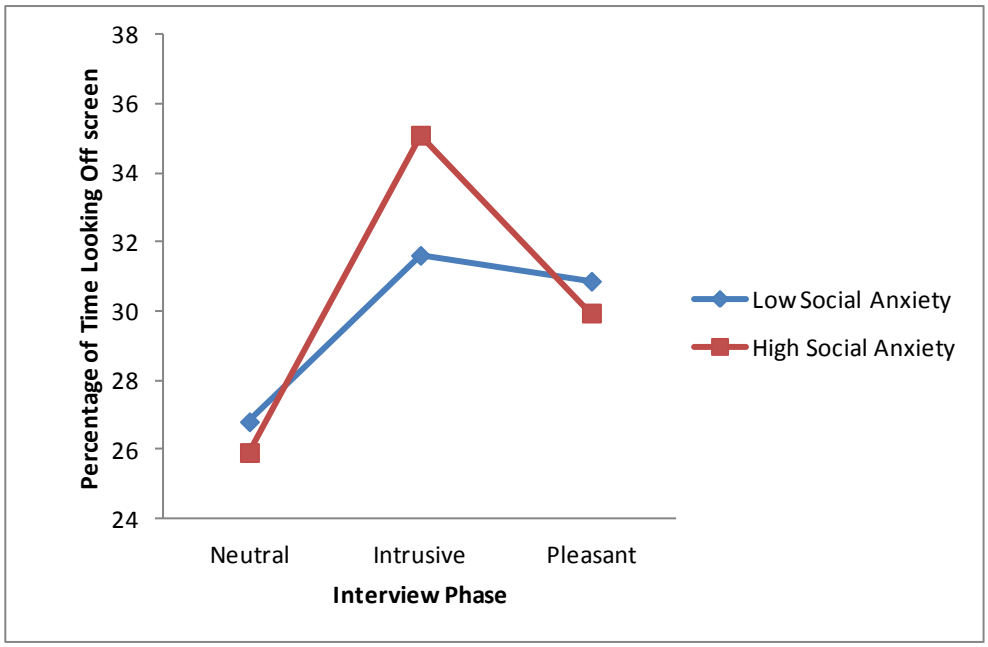

Figure 12. *Percentage of Time Spent Looking Off Screen as a Function of Social Anxiety and Late Question Periods of Interview Phases*

Percentage of Time Spent in Silence Across Interview Phases

Next, we evaluated the hypotheses that participants with higher levels of social anxiety would spend more time pausing (i.e., in silence) when responding to intrusive questions (than when responding to the neutral questions) and take longer to recover to baseline levels of pausing. The mean percentage of time spent in silence during responses was calculated for each set of questions (neutral, intrusive, and pleasant) for use in the repeated measures analyses.

Voice quality analysis was conducted on speech samples from 42 of the original 50 participants. Data was lost due to experimenter error in recording, and incomplete data.

There was a significant main effect for interview phase on percentage of time spent in silence during responses, $F(2,88) = 22.87$, $p < .01$, $\eta\rho^2 = .34$. There was also a significant interaction between question valence and composite social anxiety, $F(2,88) = 3.72$, $p = .03$, $\eta\rho^2 = .08$, indicating that level of social anxiety contributed to change in percentage of silence in interview phases. There was not a significant main effect for composite social anxiety, $F(1,44) = .02$, $p = .88$, $\eta\rho^2 = .00$.

Participants spent significantly more time in silence while responding to questions in the intrusive interview phase, $M = 33.41$, $SD = 19.03$, than in the neutral interview phase, $M = 26.34$, $SD = 18.64$, $t(46) = -5.37$, $p < .01$. Participants spent a significantly higher percentage of time in silence while answering intrusive questions, $M = 33.41$, $SD = 19.03$, than while answering pleasant questions, $M = 30.40$, $SD = 19.63$, $t(46) = 5.57$, $p < .01$. In general, participants spent a similar percentage of time in during the neutral interview phase, $M = 26.34$, $SD = 18.64$, and pleasant interview phase, $M = 30.40$, $SD = 19.63$, $t(46) = -.59$, $p = .56$.

In order to explore the interaction between interview phase and social anxiety, follow-up analyses were conducted. Difference scores were computed for each group by finding the difference in mean percentage of silence between each interview phase, which resulted in 3 scores for each group. The results of these independent samples *t*-tests did not reveal the interaction (largest difference, $t(44) = 1.89$). Subsequent visual inspection of Table 10 and Figure 13 suggested that, compared to participants lower in social anxiety, participants higher in social anxiety may have been slower to return to baseline levels of silence during speech in the pleasant phase. Greater statistical power would likely be useful in verifying this observation.

Table 10. *Percentage of Time Spent in Silence (%Silence) for Interview Phase by Social Anxiety Composite Score Group*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA	22	60.33	(9.04)	64.05	(8.11)	59.67	(8.59)
High SA	24	60.48	(6.85)	63.98	(7.35)	61.75	(7.58)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 46.

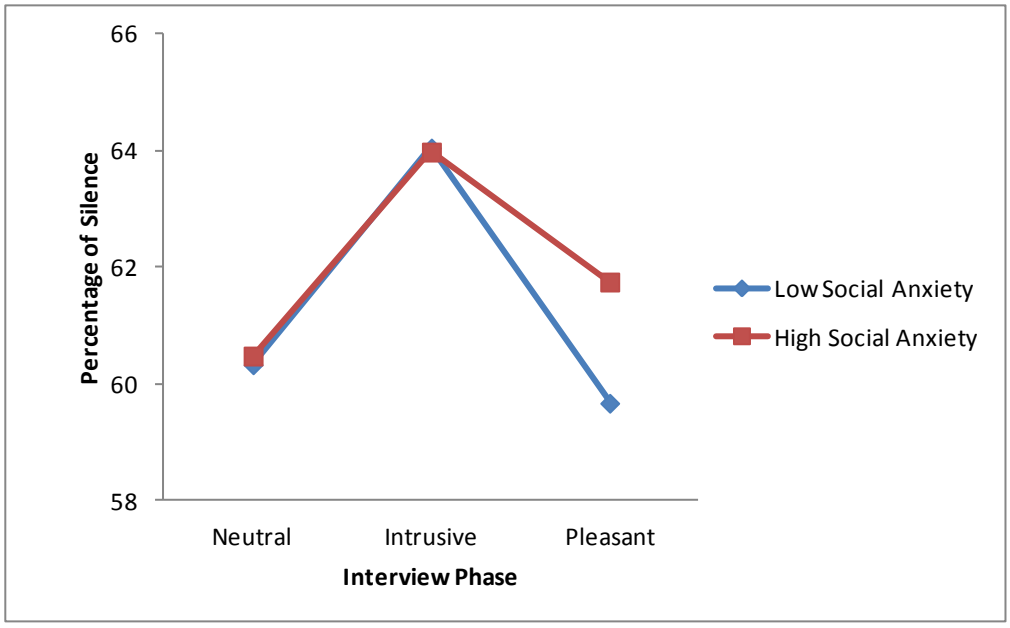

Figure 13. *Percentage of Time Spent in Silence as a Function of Social Anxiety and Interview Phase*

Exploratory Analyses

Fundamental Frequency of Speech Samples Across Interview Phases

Although no specific hypotheses were offered regarding fundamental frequency of speech, repeated measures analyses were used to examine the relationship between this nonverbal aspect of speech and social anxiety. The mean fundamental frequency and mean variation in fundamental frequency during speech were calculated for each interview phase (neutral, intrusive, and pleasant). As the voices of men and women differ in fundamental

frequency range, raw fundamental frequency data were *z*-transformed for each sex separately before inclusion in the analyses. In order to facilitate interpretation, the raw values for mean fundamental frequency and mean variation in fundamental frequency were included in Table 11 and Table 12, respectively. Voice quality analyses were conducted on speech samples from 46 of the original 50 participants. Data loss was attributed to experimenter error in recording, and incomplete data.

The mean fundamental frequency of speech was examined first. According to Mauchly's test, the data violated the assumption of sphericity, χ^2 (2) = 38.81, $p < .01$. There was not a significant main effect for interview phase on mean fundamental frequency of speech, $F(1.25,88) = .03$, $p = .90$, $\eta\rho^2 = .00$. The main effect for composite social anxiety on mean fundamental frequency and the interaction between question interview valence and composite social anxiety both failed to reach significance, $F(1,44) = 2.25$, $p = .14$, $\eta\rho^2 = .05$, and $F(1.25,88) = 1.05$, $p = .35$, $\eta\rho^2 = .02$, respectively. Visual inspection of Table 11 and Figure 14, suggested that, in general, both men and women with greater social anxiety evidenced higher mean fundamental frequency during each interview phase than participants with less social anxiety.

Table 11. *Mean Fundamental Frequency of Speech (in Hertz) for Males and Females for Interview Phase by Social Anxiety Composite Score Group*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA-F	19	212.97	(56.66)	203.09	(18.34)	201.22	(19.32)
High SA-F	19	212.17	(21.09)	209.82	(20.87)	209.20	(20.43)
Low SA-M	3	111.13	(13.52)	112.18	(14.54)	108.08	(10.65)
High SA-M	5	118.14	(10.85)	116.67	(11.26)	116.66	(13.64)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 46. F = Females. M = Males.

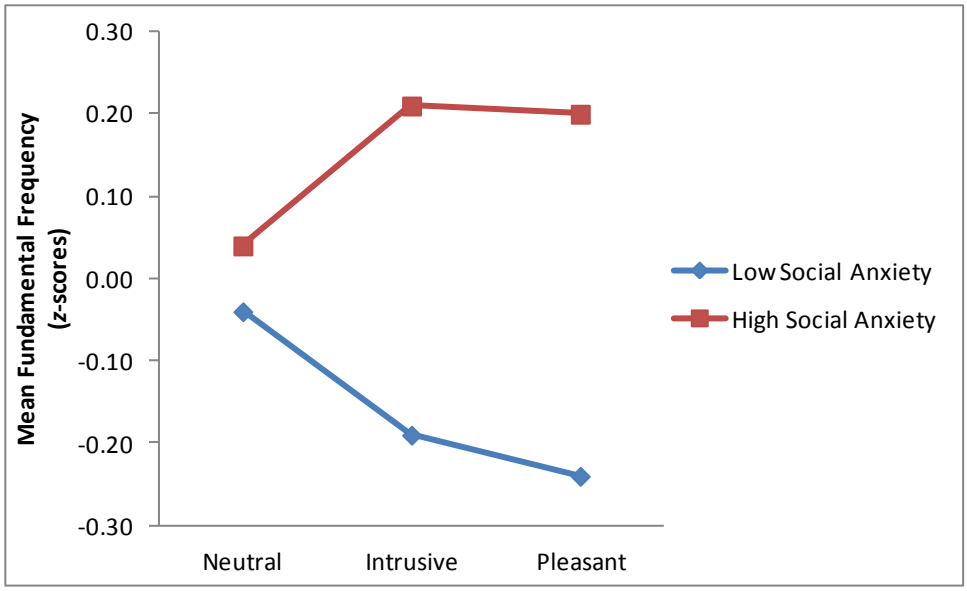

Figure 14. *Mean Fundamental Frequency of Male and Female Speech (z-scores) as a Function of Interview Phase and Social Anxiety*

Next, the mean variation in fundamental frequency during speech was evaluated using repeated measures. Mauchly's test indicated that the data violated the assumption of sphericity, χ^2 (2) = 10.43, $p < .01$. Both the main effect for interview phase and the main effect for composite social anxiety on mean variation in fundamental frequency were not significant, $F(1.65,88) = .08$, $p = .93$, $\eta\rho^2 = .00$, and $F(1,44) = 2.46$, $p = .12$, $\eta\rho^2 = .05$, respectively. Similarly, the interaction between composite social anxiety and interview phase was not significant, $F(1.65,88) = .78$, $p = .46$, $\eta\rho^2 = .02$. Visual inspection of Table 12 and Figure 15 showed that participants higher in social anxiety demonstrated less variation in fundamental frequency than participants lower in social anxiety across interview phases. This offers some support for the idea that people higher in social anxiety may display muted behavior associated with efforts to reduce the outward signs and emotional experience of anxiety during interactions.

Table 12. *Mean Variation in Fundamental Frequency of Speech (in Hertz) for Males and Females for Interview Phase by Social Anxiety Composite Score Group*

		Neutral Phase		Intrusive Phase		Pleasant Phase	
Group	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low SA-F	19	60.53	(24.81)	64.44	(27.75)	61.86	(30.55)
High SA-F	19	52.50	(11.36)	57.34	(13.58)	54.48	(13.55)
Low SA-M	3	29.24	(15.07)	29.49	(16.67)	25.08	(10.56)
High SA-M	5	21.82	(4.47)	22.07	(7.21)	21.93	(9.34)

Note. *M* = Mean. *SD* = Standard Deviation. *N* = 46. F = Females. M = Males.

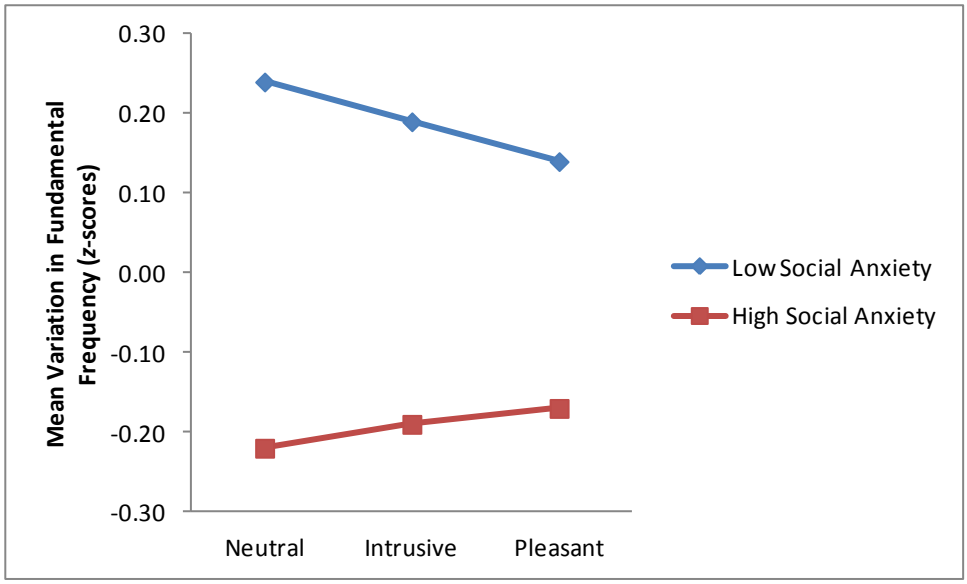

Figure 15. *Mean Variation in Fundamental Frequency of Male and Female Speech (z-scores) as a Function of Interview Phase and Social Anxiety*

CHAPTER IV

DISCUSSION

Overview

The current study was designed to investigate the relationship between social anxiety and nonverbal behavior during social interaction. More specifically, changes in eye gaze behavior and nonverbal aspects of speech were examined across emotionally evocative interviews. Findings were mixed in terms of support for the hypothesized relationships. In general, the manipulation appeared effective in inducing changes in affect and physiological arousal, and appeared to influence some nonverbal behavior in the direction generally consistent with expectations. Participants spent less time looking in the informative regions of the face (i.e., the eyes and mouth) when responding to intrusive questions and more time looking off of the screen while responding to intrusive interview questions. Similar results were found for nonverbal aspects of speech, with participants spending more time in silence during responses in the intrusive interview phase.

Hypotheses Concerning Eye Gaze Behavior

Average Duration of Fixations in the Eyes and Mouth

Eye gaze behavior of participants while they listened to questions (early question period) and while they responded to questions (late question period) were evaluated separately. The hypothesis that participants higher in social anxiety would demonstrate shorter fixation durations in the eyes and mouth in the intrusive interview phase than in the neutral interview phase was not supported in the early question period. Visual inspection of the data suggested that participants higher in social anxiety tended to have shorter face fixation durations than those lower in social

anxiety across early question periods of interview phases. Garner, Mogg, and Bradley (2006) found that people higher in social anxiety tended to have shorter fixations than their non-socially anxious counterparts, especially while viewing faces with negative expressions. Contrary to our hypothesis, the participants higher in social anxiety did not show shorter average face fixation durations in the pleasant interview phase than in the neutral interview phase. However, the large majority of fixation time in the early interview phases was spent in the eyes and mouth. While listening, people generally spend substantially more time looking at a conversation partner than while speaking (e.g. Argyle & Cook, 1967). This suggests that the listening periods of the interview phases may not have been a sensitive measure since the general tendency was to look at the person speaking.

Interestingly, in the late phases of the neutral and intrusive interviews, participants higher in social anxiety showed longer average fixations in the eyes and mouth than the participants lower in social anxiety. Contrary to expectations, participants higher in social anxiety demonstrated longer average fixations in the eyes and mouth in the intrusive interview phase which slowly decreased in the pleasant interview phase.

The intrusive phase was intended to activate the threat of negative social evaluation. As people higher in social anxiety typically use safety behaviors such as avoiding eye contact to down-regulate anxiety, it was predicted that this group would sustain only short fixations in the eyes and mouth in order to manage anxiety. However, the participants higher in social anxiety in the current study may have employed another strategy, such as spending less time looking at the eyes and mouth, to regulate emotions while responding to intrusive interview questions.

Amount of Total Fixation Time Spent Fixating in the Eyes and Mouth

It was hypothesized that participants higher in social anxiety would spend less time (out of total fixation time) fixating in the eyes and mouth during intrusive question phase and fail to recover to baseline levels of total fixation time spent fixating in the eyes and mouth during the pleasant interview phase. Participants higher in social anxiety appeared to display decreases in proportion of fixation time spent in the eyes and mouth in the early intrusive interview phase followed by increases in proportion of fixation time spent in the eyes and mouth in the early pleasant interview phase. Although there was not a significant difference between the proportion of fixation time spent in the eyes and mouth in early neutral and intrusive interview phases to support our prediction, the decreasing trend was in line with our expectations. With no significant difference between proportion of total fixation time spent in the eyes and mouth during neutral and intrusive early interview phases, the hypothesis that participants higher in social anxiety would fail to recover to baseline levels of total fixation time spent in the eyes and mouth was not supported.

Similar findings for proportion of fixation time spent in the eyes and mouth emerged for the participants higher in social anxiety during the late interview phases. Participants higher in social anxiety spent a smaller proportion of total fixation time in the eyes and mouth than participants lower in social anxiety across all late interview phases. Although there were no statistically significant results to support the hypotheses, the participants with greater social anxiety appeared to spend less time fixating in the eyes and mouth during the intrusive interview phase and show slow recovery to baseline levels of fixation time spent in the eyes and mouth during the pleasant interview phase.

The pattern of decreased time spent fixating in the eyes and mouth in the intrusive interview phase was congruent with the findings from previous studies examining eye gaze behavior in response to threatening stimuli (e.g., Horley, Williams, Gonsalvez, & Gordon, 2003). Taken with the increased face fixation durations displayed by the participants higher in social anxiety while responding to intrusive interview questions, the corresponding decrease in relative face fixation suggests that these participants managed anxiety by spending more time exploring areas other than the eyes and mouth on the display. In the early pleasant interview phase, repair to baseline levels of fixation time spent fixating in the eyes and mouth appeared to be quicker than in the late pleasant interview phase. Higher levels of anxiety have been associated with slower recovery to baseline levels of psychological and physiological arousal after a stressor (e.g., Mauss, Wilhelm & Gross, 2003). The slower rate of recovery during the late pleasant interview phase suggests that impact of social anxiety on eye gaze behavior may be more apparent during the more cognitively demanding speaking tasks. Another viable explanation for this difference is that people generally spend more time looking at a conversation partner when being asked questions, but people with greater social anxiety may direct gaze away from areas of interest (i.e., the eyes and mouth) when providing responses.

Time Spent Looking Off Screen

As a considerable portion of the eye movement data included missing data, the above analyses offered a limited view of participant eye gaze behavior across the interview phases. A difference score was calculated between the percentage of missing data in the early and late question periods as an estimate of the percentage of time spent looking off of the display screen when answering questions. In general, participants spent a higher percentage of time looking off screen when answering questions in the intrusive interview phase than when answering neutral

questions. Although the interaction between composite social anxiety and interview phase was not significant, it appeared that participants with greater social anxiety showed a more pronounced increase in percentage of time spent looking off screen when answering intrusive questions than participants with lower social anxiety. This observation is consistent with previous findings that people with social anxiety generally make less eye contact than their non-socially anxious counterparts in a variety of social contexts such as during interviews (Daly, 1978) and while giving speeches (Eves & Marks, 1991). Although the percentage of time spent looking off screen increased for all participants in the intrusive phase, participants with greater social anxiety may have relied more heavily on looking off screen to regulate anxiety related to the aversive social stimuli.

Summary of Eye Gaze Behavior Results

Overall, participants with greater social anxiety performed similarly to participants lower in social anxiety when listening to interview questions. This was congruent with the general expectation that people tend to direct gaze towards the speaker when being asked questions. Although participants higher in social anxiety appeared to make the longest average fixations in the eyes and mouth when answering intrusive questions, they also spent the smallest proportion of fixation time in the eyes and mouth at this stage. This suggests that participants higher in social anxiety may rely on establishing long and infrequent fixations within informative regions of the face (i.e., the eyes and mouth) when responding to aversive social stimuli. In addition, the percentage of time spent looking off of the screen when responding to intrusive interview questions appeared to increase more dramatically for participants with greater social anxiety than those with lower social anxiety. These findings suggest that participants with greater social anxiety were able to display appropriate eye gaze behavior when listening to questions.

However, increased avoidance of the eyes and mouth when answering questions, especially in the intrusive interview phase, offers some support for differences in eye gaze behavior of participants higher in social anxiety attributing to social interaction deficits.

Hypotheses Concerning Nonverbal Aspects of Speech

Percentage of Time Spent in Silence

It was hypothesized that participants higher in social anxiety would spend more time in silence while responding to intrusive interview questions than while responding to neutral interview questions. The statistically significant increase in percentage of silence during the intrusive question phase supported this expectation. Although participants higher in social anxiety demonstrated a similar pattern of pausing as participants lower in social anxiety, the low social anxiety group recovered to baseline levels of pausing more quickly in the pleasant interview phase. Contrary to expectations, the participants higher in social anxiety did not display significant differences in percentage of time spent in silence between neutral and pleasant interview phases. The pattern of increased silence shown during the intrusive interview phase was similar to those found in other studies using stressors to analyze speech (e.g., Laukka et al., 2008). These findings suggest that participants with greater social anxiety may display deficits in the ability to move on and repair to baseline levels of pausing during speech after negative emotional activation. Periods of silence add communicative value to speech in appropriate contexts (e.g., pausing for emphasis). People high in social anxiety may confuse or frustrate conversation partners by demonstrating similar pausing in response to both aversive and pleasant interactions.

Mean Fundamental Frequency and Variation in Fundamental Frequency

Although no specific hypotheses were offered for the relationship between fundamental frequency and social anxiety, the findings from exploratory analyses were notable. In general, the speech of participants with greater social anxiety appeared to be higher in frequency than the speech of participants with low social anxiety across interview phases. This is in line with general expectations as well as findings from Laukka and colleagues (2008). Furthermore, participants higher in social anxiety appeared to produce speech with more restricted variation in fundamental frequency than the speech of participants lower in social anxiety. This matches up well with the notion that people with greater social anxiety may over-control behavior, resulting in decreased expressive behavior. Anecdotally, lively or intense interactions are characterized by greater variation in intonation. A lack of variation in fundamental frequency during conversation may communicate disinterest to a speaking partner when that may not be the case. Participants with greater social anxiety may communicate unintended messages due to lack of appropriate intonation during speech.

Limitations

The limitations of this study should be addressed in future research. One notable limitation to the current study was the small sample size. As less than fifty participants had complete data for either eye gaze behavior or speech, power was limited in the analyses performed using two groups. Due to the small sample size, a median split was used to create the high and low social anxiety groups. Using social anxiety groups at the extremes of the social anxiety score distribution would likely increase the chances of observing more substantial group differences in the variables of interest.

In regards to the interview stimuli, the use of three different interviewers may have had unintended effects on eye gaze behavior. Participants may have reacted differently to the novelty of the interviewer changes. Using one interviewer across all three phases would allow for firmer conclusions regarding the impact of interview valence, independent of interviewer, on nonverbal behavior.

Finally, data collection procedures should be modified in future studies. A considerable amount of eye movement data was labeled as missing. Both calibration error and time spent looking off of the computer screen were grouped into this variable. In the current study, accuracy of the eye tracker calibration was checked once near the beginning of the experimental protocol. Future studies should include brief checks of the calibration throughout the experiment in order to draw stronger conclusions about the meaning of missing data. In addition, the time spent responding to each question should be recorded for all participants in order to facilitate comparisons with early question period data.

Conclusion

The aim of the current study was to examine the relationship between social anxiety and nonverbal behavior during emotionally evocative social interaction tasks. Despite the limited statistical support for hypotheses of the current study, trends in nonverbal behavior were in the expected directions. Participants demonstrated the greatest behavioral changes in eye gaze and voice quality when responding to intrusive interview questions. Participants higher in social anxiety reported more negative affect and physiological arousal than those lower in social anxiety following the intrusive interview phase. This elevated emotional activation for people with greater social anxiety was most prominently manifested by increased percentage of time spent looking off screen, and decreased proportion of fixation time spent in the eyes and mouth.

In addition, participants higher in social anxiety were slower to return to previous levels of silence in speech after the intrusive interview phase and displayed speech with higher fundamental frequency and attenuation of intonation.

Overall, there is some evidence that people with greater social anxiety display nonverbal behaviors that impede their social functioning. The expectation that people higher in social anxiety engage in safety behaviors in order to down-regulate anxiety appears valid. By avoiding the information laden areas of the eyes and mouth when speaking, people higher in social anxiety miss opportunities to receive nonverbal feedback from others and may inadvertently communicate a desire to end the social interaction. Furthermore, people with greater social anxiety may unintentionally limit their range of emotional expression through over-controlling variation in intonation while speaking. These trends in eye gaze behavior and nonverbal aspects of speech implicate are implicated as important contributors to the interaction difficulties of people high in social anxiety.

APPENDICES

APPENDIX A

PLEASANT, INTRUSIVE, AND NEUTRAL INTERVIEW QUESTIONS AND INTERVIEW DIALOGUE

Neutral Interview Questions

1. "What are your personal goals for the next ten years or so?"
2. "If you could travel anywhere in the world, where would you go and why?"
3. "Tell me about your first job."
4. "What qualities do you look for in a roommate?"
5. "Tell me a little bit about where you grew up."
6. "Describe a typical weekday evening."
7. "What are the most important factors in choosing a class?"
8. "How do you typically spend a day off?"

Intrusive Interview Questions

1. "What are your usual ways of dealing with anxiety?"
2. "Who are the persons in your life you most resent and why?"
3. "What characteristics of your parents do you dislike?"
4. "What are your feelings about your sexual adequacy?"
5. "What are some qualities that you wish you could change about yourself?"
6. "What has been the most embarrassing moment in your life?"
7. "Describe the last time a relative annoyed you."
8. "When was the last time you felt you made a fool of yourself?"

Pleasant Interview Questions

1. "What is something you are especially proud of?"
2. "What are some things you look forward to in the next year?"
3. "What things make you the happiest in your life right now?"
4. "What is one of your warmest family memories?"
5. "If you had unlimited resources to help others, what would you like to do?"
6. "Describe the last time someone complimented you and why?"
7. "What have you done that has made you the most proud in your life?"
8. "Describe the last time someone genuinely thanked you."

Prompts for Additional Information

1. "Tell me some more about that."
2. "Ok. Please say some more about that."
3. "Um huh, what more can you tell me?"
4. "What else?"
5. "Expand on that for me."
6. "Please answer more completely."
7. "Please add more details."

Introduction

"I am going to ask you a few questions and I just want you to answer them as openly and honestly as possible. Please take your time and answer each question thoughtfully."

Transitioning Statement between Interview Blocks

"I am going to ask you a few more questions and I just want you to answer them openly and honestly."

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