Am I blushing? The effect of social anxiety on physiological blushing, perceived level of blushing and correlation with the Big Five personality traits.

Danielle Mepham

Supervised by: Professor Cecilia Essau

March 2010

Am I blushing? The effect of social anxiety on physiological blushing, perceived level of blushing and correlation with the Big Five personality traits.

ABSTRACT

Previous research indicates a strong relationship between social anxiety and blushing (Edelmann 1990). However, conflicting results have been found. The aim of this study is to examine the effect of social anxiety upon physiological and perceived blushing and the relation with personality traits. A quantitative mixed design was performed consisting of completing a set of questionnaires and a speech task. An undergraduate sample (N=42) was used. The results showed a positive association between social anxiety and blushing propensity, social anxiety and problems with blushing and interaction between these three factors. High or low scores of social interaction anxiety, participant condition and blushing temperature were also found to interact. Low scorers of social anxiety had heightened blushing temperature post-speech task, whereas in the blushing condition had an increased temperature before. High scorers within both conditions had heightened temperatures post-interaction. Multiple regression analysis supported positive relation between social anxiety, neuroticism and blushing propensity. Extraversion negatively correlated with social anxiety. It is concluded that social anxiety does affect blushing and personality. Implications for treatment are discussed including the use of blushing as a psycho-physiological marker for the diagnosis of social anxiety.

KEY WORDS:	SOCIAL ANXIETY	BLUSHING	PERSONALITY	SIAS	UNDERGRADUATES

Introduction

Social anxiety is defined as intense and persistent fear of social or performance situations which can result in positive and negative effects. Social anxiety is a common condition that affects more than 10% of the population in varying extremities (Mannuzza et al. 1995). Symptoms that individuals with social anxiety can exhibit include the inability to speak, sweating and blushing. Blushing is a very common symptom of social anxiety defined by episodes of erythema concentrated on the face caused by increases in blood flow (Callejas 2009).

There has been a growth in research focusing on the association between social anxiety, blushing and their effects upon individuals. One area which has been focused upon is the physiology of blushing. For instance, research has been conducted on social phobic (Gerlach, Wilhelm, Gruber & Roth 2001) and clinically anxious participants (Edelmann & Baker 2002) with and without blushing complaints and the difference between their blushing levels. Social phobic participants with blushing complaints, who did not blush anymore than those without, however did suffer from increased heart rate (Gerlach et al. 2001). The same being found for clinically anxious participants (Edelmann et al 2002).Yet in Gerlach et al. (2001), the study showed raised heart-rate was found when participants were watching an embarrassing video and not in a speech or interaction task as in other studies. An un-balanced sample (32 clinical patients and 18 controls) were used in the Edelmann et al (2002) study which could also influence results. However, Voncken and Bogel's (2009) study used a speech task and consisted of a larger sample of social anxiety disorder (SAD) patients with blushing complaints, where heightened physiological blushing was displayed compared to controls. This finding conflicts with previous research (Gerlach et al., 2001; Edelmann et al., 2002) which did not find evidence of heightened blushing. This study did suffer from several full and partial equipment failures where data was lost and disruption to the study was caused. Heart rate was not measured thus it could not be compared to previous findings.

According to several authors, fear of blushing affects blushing propensity within individuals. Furthermore, highly anxious individuals have been shown to exhibit greater cardiovascular threat response than low anxious participants within social interactions, (Shimizu, Seery, Weisbuch & Lupien 2011). Embarrassment,

associated with social anxiety also causes the same autonomic effects, (Hofmann, Moscovitch & Kim 2006). Embarrassing situation methods (for example, singing in front of confederates) are often used to demonstrate this effect within individuals with a fear of blushing. Mulkens, de Jong, Dobbelar and Bogels (1999) found that participants with a fearful preoccupation blush significantly more irrespective of facial coloration, although no cheek temperature differences were found between high and low fearful participants. Other studies have contradicted this result, finding no difference between participant's blushing propensity, (de Jong & Peters 2005; Drummond et al. 2007). However, Drummond et al. (2007) also found embarrassment was heightened in fearful participants and their blushing dissipated slower than within controls. Although, only a small sample was used and only one physiological measure was recorded which did not give an autonomic overview of blushing.

Much research has also concentrated on the concept of individuals with a fear of blushing showing revealing affects within social situations. Blushing-fearful participants have been found to overestimate fearful outcomes as a consequence of blushing, (de Jong et al. 2005). Recently, de Jong et al. (2005) found that fear of blushing is not fuelled by a biased view of its communicative or revealing affects within a social situation though. Even so, irrespective of a participant's fear of blushing, negative effects are still attributed to the event of blushing, (Dijk & de Jong 2009). This could be as a result of previous research showing that individuals who blush assign negative perceptions to themselves. Social phobic individuals report negative thoughts about themselves, perceive themselves as inadequate and this reflects the way their peers feel towards them (Rapee, 1995; Creed & Funder 1998). Socially anxious individuals are perceived as fearful, self-pitying, unassertive, having a lack of social skills and awkward by themselves and peers (Creed et al 1998). Social anxiety was therefore shown as having a negative effect on peers which leads to an interpersonal cycle of social anxiety. However, converse to earlier studies, Dijk, de Jong and Peters (2009) found that blushing actors were rated more favourably than non-blushing actors, demonstrating how blushing is not always seen as undesirable and can in fact "save face". However, participants were only tested in one situation when it has previously been found that the communicative function of blushing is dependent upon context (de Jong, Peters, de Cremer & Vrancken 2002;

de Jong, Peters & de Cremer 2003). The sample also only consisted of females which leads to a lack of external validity, as blushing has been shown to differ between sex and skin colour, (Drummond & Lim 2000).

Much research concludes that self-focus and awareness lead to the negative affect and perception found in blushing individuals and causal factors in blushing initiation. Edelmann (1990) found that there was a significant positive correlation between blushing severity, effect and the social anxiety subscales of the self-consciousness scale. Consequent research has supported this finding, self-focused attention has been found to increase social anxiety and task-focused attentions lead to a decrease, (Bogels & Lamers 2002; Bogels, Rijsemus & de Jong 2002).However, the Bogels et al.(2002) study suffers from a lack of ecological validity as a result of the researchers using hypothetical scripts rather than a speech task or interaction. Surprisingly, heightened self-awareness has been found not to effect facial colouration, negative thinking or task performance. But, high socially anxious participants do blush more than low socially anxious participants when increasingly self-aware or focused, (Bogels et al 2002; Zou, Hudson & Rapee 2007). Although, to induce self-awareness in the Bogels et al (2002) study, mirrors were used, therefore participants could observe their level of blushing, (Bogels & Mansell, 2004). In addition, although the Zou et al. study (2007), used a conversation interaction rather than a speech, it did use a primarily female sample thus lacking external validity. Moreover, no physiological measures were recorded thus no subjective measures were included within the experiment. Yet, this is true of much of the research on self-focusing, therefore studies which include physiological measurements of focus, symptoms of blushing and social anxiety need to be pursued.

There is evidence that self-performance is also closely linked with the self-awareness of the participant. Research has shown, social anxiety symptoms correlate with prediction of poorer self performance (Boschen & Curtis 2008). This supports the link between social anxiety and low self-perception hence leading to a possible increase in blushing. However, an analogue sample was used which leads to a lack of external validity. Nevertheless, researchers have debated whether under-estimation or actual social performance is linked to social anxiety. Voncken and Bogels (2008) examined SAD patients completing a speech and conversation task. It was found that social performance deficits were present in the conversation but not

in the speech. It was argued that conversations need more interpersonal skills thus more social performance deficits are displayed, whereas speech tasks are more likely to increase cognitive distortions, supporting previous research, (Edelmann et al., 2002). Nonetheless, there are problems with this study, one of which being that only referred patients where used. Due to the sample, social behaviour and anxious appearance problems may appear to be more prevalent as these could be exacerbated in severe psychopathology compared to individuals without an SAD. The findings could also be exaggerated as a result of two confederates being used in the conversation task rather than one which results in attention having to be divided two ways which is more complex.

Cognitive distortions are when individuals distort information from the environment, often to reinforce negative thought patterns which can lead to increased anxiety. Miers, Blote, Bokhorst and Westenberg (2009) examined whether negative self-evaluations are associated with self-performance. Participants performed a speech in front of peers and a teacher. High socially anxious participants demonstrated negative evaluation for nervous appearance regardless of their performance. Negative bias for social skills was only demonstrated in good performances by high socially anxious participants, in contrast to Voncken and Bogels (2008) and Anderson and Hope's (2009) studies. These inconsistent findings could be due to previous studies not controlling for performance level when investigating self-evaluation of social skills. Yet, there are other limitations which could also contribute, for instance, a community sample was used with no clinical control employed. Secondly, it is debatable whether adults should have been used as rating confederates, when research has demonstrated that peer's opinions are valued more by adolescents (Westenberg, Drewes, Goedhart, Siechelink, & Treffens 2004; Steinberg & Monahan 2007).

Voncken, Dijk, de Jong and Roelefs (2010) argue whether increased self-focused attention leads to poor self-performance rather than negative beliefs in social anxiety. The findings showed that negative beliefs were associated with poor self-performance rather than self-focused attention which was seen as a by-product of social anxiety. Yet, self-focused attention was only measured via an explicit self-report measure and only used an analogue population. However, Tuschen-Caffier, Kuhl and Bender (2011) found children suffering from SAD and subclinical anxiety

displayed heightened anxiety and negative thoughts compared to controls. However, no group differences were found within self-performance contradicting the Voncken et al (2010) study. Although, a semi-structured interview was used to assess participants rather than report measures and only one rater was used which lacks internal reliability. No control for co-morbid disorders such as depression were in place either, which could confound results as depression is known to influence levels of negative cognitions and self-evaluation (Rimes & Watkins, 2005; Nasir, Zamani, Yusooff, & Khairudin 2010). If the impact of the previously mentioned factors upon social anxiety and blushing are to be followed, verbal feedback from others could also have considerable effect.

The impact of verbal feedback upon self-performance has been found to have highly significant effects on blushing propensity and social anxiety. Participants who perceive they are prone to blushing have been found to be more self-conscious but do not actually blush anymore than others (Drummond, 2001). The expectation to blush could therefore raise the likelihood of blushing. However contradictory findings have been found which propose that the expectation to blush is a self-fulfilling prophecy and if a participant thought that they were blushing or likely to they would blush more on average (Drummond, Camacho, Formentin, Heffernan, Williams & Zekas 2002), report greater anxiety, have poorer perceived performance and display more physical indicators of anxiety, (Wild, Clark, Ehlers & McManus 2008). Participants informed through false feedback that their arousal had risen also overestimated the visibility of anxiety and underestimated their performance. However, only a student sample was used and physiological changes were not measured (Wild et al., 2008). Interestingly when false feedback was given to participants with a fear of blushing, high fearful participants displayed intense blushing throughout the interaction regardless of receiving feedback or not, whereas low fearful participants showed heightened response only if receiving feedback, (Dijk, Voncken & de Jong 2009). When participants receive feedback it has been found that participants perceived confederates as judging them negatively, (Dijk et al 2009) which supports the finding that low fearful participants only display a response when receiving feedback from a confederate and confirm the association of social anxiety, blushing and cognitive distortions in high fearful participants. Although, a student sample was used, this limits the generalization of results.

The personality of an individual has far-reaching implications in an individual's everyday life. This includes the correlation between personality factors and social anxiety which could cause future problems such as the tendency to blush. Personality predictors have been found which are commonly associated with individuals with blushing complaints. For Instance, Leary and Meadows (1991) found four different predictors: embarassability, interaction anxiousness, self-esteem and refinement accounted for 40% variance in blushing propensity. Neto (1996) also found comparable results with the four personality predictors of shyness, being the centre of attention, social anxiety and sociability accounting for a 52% variance in blushing propensity. It has been found that severity of social anxiety within participants negatively relates to emotional stability, (Bunevicius, Katkute & Bunevicius, 2008) Similar findings have been found when examining social phobia which correlates with low extraversion and neuroticism supporting Heiser, Turner and Beidel's (2003) study (Kotov, Gamez, Schmidt & Watson, 2010).

As demonstrated, the lack of research within the area of association between social anxiety, blushing and personality factors and the limitations of the previous studies have caused a lack of clarity within the field. The aim of this study was to investigate the associations between social anxiety, blushing and personality traits to fill a gap in the current research. This study examined these three variables in correlation with one another which no current piece of research has achieved. In light of the limitations of previous studies which suffered from various methodological differences, the present study will use various self-report tools and two methods of physiological measurement to gain a more reliable and applicable outcome.

More specifically, the hypotheses of this study were as follows:

1) Social anxiety is relatively common in university students.

2) The higher the level of social anxiety, the higher the level of blushing.

3) There will be discrepancies between the physiological indicators of blushing and self-report by participants.

4) Participant's blushing levels will be higher the poorer the rating of subjective self-performance.

5) Some of the Big Five personality dimensions will correlate with the levels of social anxiety and blushing propensity found in participants.

Method

Design

The present study is of quantitative mixed design using experimental and questionnaire methods. The combined use of methods has been chosen to give a more accurate view of the phenomena of blushing as the experiment needs physiological indicators which can only be gained from experimental method. Such as, the speech task and its physiological analysis through heart rate recording and using thermo-camera imaging to measure blushing. The proposed research questions will be examined more accurately and with less criticism if just one method were used. The questionnaire part of the study will be used to determine the participant's perceived view and experience of blushing and personality factors to compare the physiological indicators to.

Participants

The participants consisted of 42 Roehampton university students between the ages of 17-52 with a mean age of 22.4 years (SD= 6.9). These consisted of 10 males and 32 females. Participants were randomly allocated to one of the 2 conditions: task condition and a blushing condition. There were 18 participants in the blushing condition and 24 in the task condition. Participants were a convenience sample recruited by the experimenter, via computer system and poster advertisements.

Materials and Apparatus

The equipment for the experiment was set up to ensure the participant was facing the camera but could also see the researcher. The computer was facing towards the researcher letting the experimenter see the results without the participant also observing. The same room was always used and no one else had access to the room. The layout for the experiment is shown in Figure 1 below:

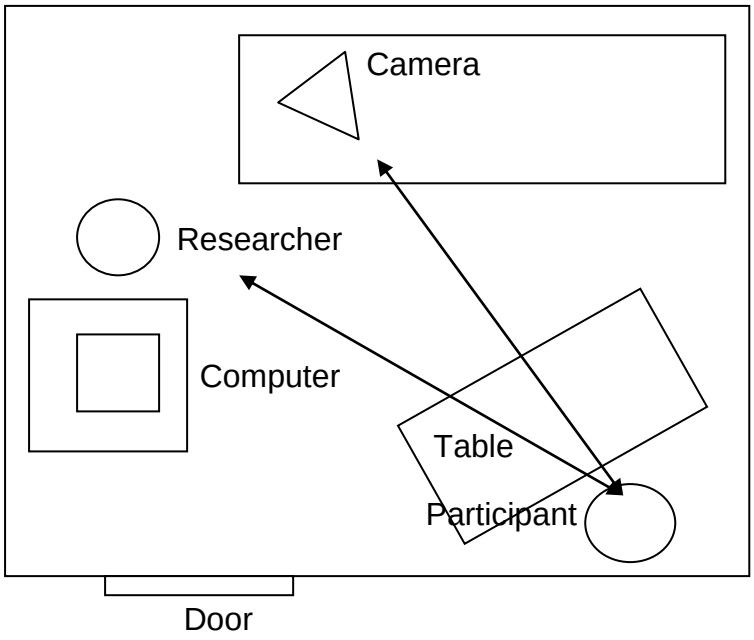

Figure 1: Diagram of the experimental set-up.

A computer (Dell Precision 380 with Pentium 4 3Gz dual core with 1 GB RAM running Win XP) was used to display the video whilst the experimenter watched the task and the display of the recording and readings from the thermo vision camera (A series, A320 Researcher Pro). The thermo vision camera was needed to record the temperatures of the cheeks of the participants. A Polar RS 400 heart rate monitor watch was also employed to measure heart rate during the experiment.

Questionnaires

There were also a number of questionnaires employed for the participant to complete as shown below which reliability tests were performed on.

The Social Interaction Anxiety Scale: SIAS (Mattick and Clarke 1998) consists of 19 items which measure social interaction anxiety within different social situations such as “I have difficulty making eye-contact with others”. The scale is rated between 0 (Not at all) and 4 (Extremely). A Cronbachs alpha of .91 was achieved which means that the scale has excellent reliability.

The Brief Fear of Negative Evaluation scale: BFNE (Leary, 1983) has 12 items which calculates how concerned the individual is of other’s views. For instance, one item being: “I am afraid that others will not approve of me”. The questionnaire is

scaled between 1 (Not at all characteristic of me) and 5 (Extremely characteristic of me). A Cronbachs alpha of .92 was achieved which demonstrates that the scale has excellent reliability.

The Blushing Propensity Scale: BPS (Leary & Meadows 1991) consists of 14 items on a scale of 1 (I never feel myself blush in this situation) and 5 (I always feel myself blush in this situation). An example situation being, “When talking to a teacher or boss”. This measures the subjective view of the individual’s amount of blushing in certain situations. A Cronbachs alpha of .91 was achieved which shows excellent scale reliability.

The Blushing, Trembling and Sweating Questionnaire: BTSQ (Bogels & Reith, 1999) consists of 3 different sub-scales; the first measuring the extent of bodily reactions when blushing such as “cheeks become red/pink” and is rated between 0 (Not) and 4 (Very strong). The second sub-scale measures the effect of blushing on the individual’s everyday life and is scaled between 0 “Not afraid at all” and 4 “Very afraid”. One example of an item is: “How afraid are you while you blush?” The last subscale measures reactions when blushing such as “Problems concentrating” on a scale between 0 (Not) and 4 (Always). A Cronbachs alpha of .89 was achieved which demonstrates good scale reliability.

The Anxiety sensitivity interaction scale revised: ASI-R (Peterson & Reiss 1992) comprises of rating scale ranges between 0 (Very little) and 4 (Very much). The scale measures anxiety sensitivity in social interactions with items such as “It is important for me not to feel nervous”. A Cronbachs alpha was performed where the scale demonstrated excellent reliability (.91).

When answering The Big five inventory (BFI) (John, Donahue & Kentle, 1991), questions had to be completed by answering on a scale of 1 (Disagree strongly) to 5 (Agree strongly). The scale measures different traits and behaviours of the individual such as “I am someone who has an assertive personality”. A Cronbachs alpha of .53 was found which demonstrates poor reliability.

A Socio-demographic Scale also had to be completed which asked for general details of the participant including age and ethnicity for use in descriptive statistics. A self-performance rating form was also completed which consisted of 17 items such

as “Had a clear voice” which the participant had to answer on a scale of 0 (Not at all) and 4 (Very much). This was to give the researcher a subjective view of self-performance from the participant. A sheet with three tables for recording the participant’s heart rate, subjective blushing temperature and how anxious the participant was (On a scale of 1=Not anxious to 10=Very anxious) was also utilised.

Procedure

The participant was introduced to the researcher and seated in the laboratory where they were given a consent form. Once the consent form had been read and signed, self-report questionnaires were given for the participant to complete. Once completed the participant was asked to put the heart rate monitor and watch on. They were then told they would have to prepare a 2 minute speech on any topic and would be given an additional 2 minutes to prepare what they were going to say. During the 2 minutes, the researcher turned on the two cameras. At the end of the two minutes the participant was asked to complete a chart estimating how hot they felt in degrees, how anxious they were on a scale of 1-10 and their heart rate. The participant was then asked how hot they felt, and the researcher replied with the actual temperature of the participant’s cheeks.

The participant was then randomly assigned to 1 of the 2 conditions: A blushing condition where whilst the participant performs the speech they were to concentrate on how hot they felt, especially their cheeks. In the control/task condition the participant was asked to focus on their speech deliverance and content as they were told they would be judged whilst talking.

After, the two minutes the researcher asked if they were ready and informed them depending on the condition they were assigned to what they had to focus on. The camera and stopwatch were then started and when notified the participant proceeded with their speech. The participant had to be recorded for the whole two minutes, even if not speaking. Once the two minutes had ended, the researcher notified the participant and stopped the recording. The subject then rested for 2 minutes and completed the chart stating how hot they felt, how anxious they felt and their heart rate. The researcher also took the blushing temperature measurement at this point.

Once completed, the researcher again asked the participant how hot they thought they were and informed the participant of their actual temperature. They were then asked to complete another short questionnaire based upon their self-performance rating of their behaviours throughout the recording of their speech. After completion, the heart rate monitor was removed from the participant and all equipment turned off. The debriefing was given and the researcher stated their thanks and informed them that if they have any questions they could contact them using the details on the debriefing sheet. The participant was then led out.

Ethical issues

Informed consent had to be given to partake in the study. To ensure confidentiality, participants were assigned a participant number to protect their identity. This also gave them the right to withdraw their data from the study freely, by recalling the number to the researcher. All data was kept safely on computer, USB and files by the researcher.

Results

Descriptive statistics

The raw data collected from the experiment was put into SPSS to be analysed. The tables below show some of the frequencies obtained from the data (Table 1).

Table 1: Sociodemographic characteristics of the sample.

		N	**%**
Age	17-20 years	23	54.8
	21-57 years	19	45.2
Mean and Standard deviation	M=1.45 SD=.50		
Marital Status	Single	38	90.5
	Married/Living with partner	4	9.5
Gender	Male	10	23.8
	Female	32	76.2
Mean and Standard deviation	M=1.76 SD=.431		
Ethnicity	British	16	38.1

	European	6	14.3
	Caribbean	7	16.7
	Asian	7	23.8
	African	4	9.5
	American	1	2.4
	Other	1	2.4
Religion	Christian	22	52.4
	Muslim	5	11.9
	Hindu	1	2.4
	Other	1	2.4
	None	13	31.0
International student?	Yes	5	11.9
	No	37	88.1

Inferential statistics

Commonality

Table 2 shows the means and standard deviations of all the study variables.

Table 2: Mean and standard deviation of all experimental variables.

Variables	*M*	*SD*
Total social interaction anxiety	21.50	12.13
Total blushing propensity	8.51	5.56
Total problems with blushing	39.45	10.93
Total personality scale	152.36	15.32
Heart rate 1	78.95	12.05
Heart rate 2	81.67	13.41
Subjective Blushing 1	24.12	5.65
Subjective Blushing 2	31.76	7.32
Real Blushing 1	32.29	1.18
Real Blushing 2	32.75	1.25
Total fear of negative evaluation	33.85	10.08
Total anxiety sensitivity	25.67	12.98
Extraversion	26.67	6.34
Agreeableness	34.90	4.71
Conscientiousness	27.95	4.66
Neuroticism	23.26	7.13
Openness	37.62	10.17
Performance rating form total	29.80	6.48

The individual items from the social interaction anxiety scale were also analysed to examine which items scored most highly within the university sample population. The following 5 items scored the most highly:

Item 10- “I find it easy to think of things to talk about”

Item 8- “I am at ease meeting people at parties”

Item 1- “I get nervous if I have to speak with someone in authority (teacher, boss, etc.)”

Item 3- “I become tense if I have to talk about myself or my feelings.”

Item 11- “I worry about expressing myself in case I appear awkward.”

Social anxiety and blushing

To investigate whether there was any association between social anxiety and the level of blushing in participant’s a Spearman’s one-tailed, bi-variate correlation was used at the 0.05 significance level. It was found that there was a significant correlation co-efficient between total blushing propensity and total social interaction anxiety at r (39) =.36, p=.01, indicating that participants with a high level of social interaction anxiety were likely to report a higher level of blushing propensity. Blushing propensity being how often the participant blushes. There were also two significant correlation co-efficients found at the 0.01 level between total social interaction anxiety and total problems with blushing r (40)= .54, p=.00, implying the higher the level of social interaction anxiety a participant has the total problems with blushing also increase. Total problems with blushing and total blushing propensity at r (41) =.69, p=.00, also showed a positive correlation co-efficient indicating the more problems with blushing a participant has, there blushing propensity also increases. These figures are demonstrated below in Table 3:

Table 3: Correlations found between total social interaction anxiety, total blushing propensity and total blushing problems.

	Total social interaction anxiety	**Total blushing propensity**	**Total problems with blushing**

Total social interaction anxiety	Spearmans Rho	1	.36*	.54**
Total blushing propensity	Spearmans Rho	.36*	1	.69**
Total problems with blushing	Spearmans Rho	.54**	.69**	1

*Note: *p<0.05, **p<0.01*

These results demonstrate that there is a strong association between social anxiety and participant's level of blushing.

Physiology and self-report

To discover whether there were any discrepancies between the physiological indicators of blushing and the self-report of blushing by participants, firstly, 3 separate mixed ANOVAS(3x2x2) were carried out focusing on each of the physiological indicators, (Heart rate, temperature of blushing and subjective temperature of blushing. The Bonferroni method was used to give more conservative and accurate results compared to a Tukey analysis, the statistical significance being set at .005. Mauchly's test of sphere city was non-significant therefore the variances of differences are roughly the same and sphericity can be assumed. Subjective blushing temperatures were analysed as the dependent variable with condition, high or low SIAS results and the interaction between all of these factors. A median split upon total social interaction anxiety scores was performed to create the new variable of high or low social interaction anxiety results. Subjective blushing interaction with condition, $F(1,36)=.91$, $p=.35$, subjective blushing interaction with high and low social interaction anxiety scores, $F(1,36)=.42$, $p=.520$ and subjective blushing interaction with condition and high and low social interaction anxiety, $F(1,36)=.01$, $p=.928$.This indicates that condition and high or low social interaction scores have no effect upon ratings of subjective blushing.

Secondly, the temperatures of the participant's blushing were analysed as the dependent variable with condition, high and low social interaction scale score total and the interaction between the variables. The interaction between the real blushing temperature and condition was significant at $F(1, 36) =.120$, $p=.005$. The interaction between real blushing temperature and high and low social interaction anxiety

scores was found not to be significant at F (1, 36) =1.35, p=.25. However, an interaction was found between real blushing temperature, participant condition and high and low social interaction scores at F (1, 36) =4.23, p=.047. This demonstrates that although the variables do not have a significant effect on real blushing temperature separately, they do interact with one another to give a significant effect. To explore the interaction between real blushing temperature, participant condition and high or low social interaction anxiety scores, two graphs shown below (Figure 1 and Figure 2) were produced to show the direction of the interactions clearly. The differences between the variable interactions are also clearly demonstrated. The first graph (Figure 2) shows the interaction between high and low social interaction anxiety scorers, participant condition and the first blushing temperature recorded before the interaction. The second graph (Figure 3) represents the interaction between high and low social interaction anxiety scores, participant condition and the second blushing temperature recorded after the interaction.

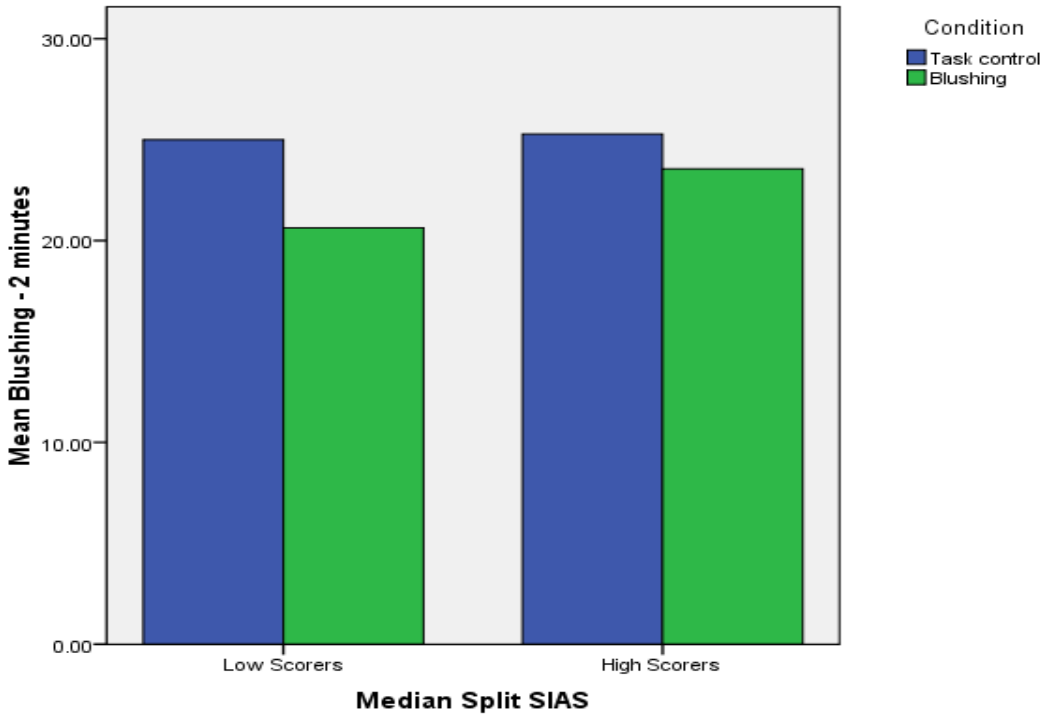

Figure 2: The interaction between subjective blushing temperature, condition and high or low scorers of social interaction anxiety pre-interaction

The graph shows that within the task control group low scorers on total high and low social interaction anxiety scores had low blushing temperatures whilst if in the blushing condition had a much higher temperature of blushing. High scorers on the total social interaction anxiety scores demonstrated the opposite pattern; if placed in the task control group; high scorers had a higher blushing temperature than if within the blushing condition.

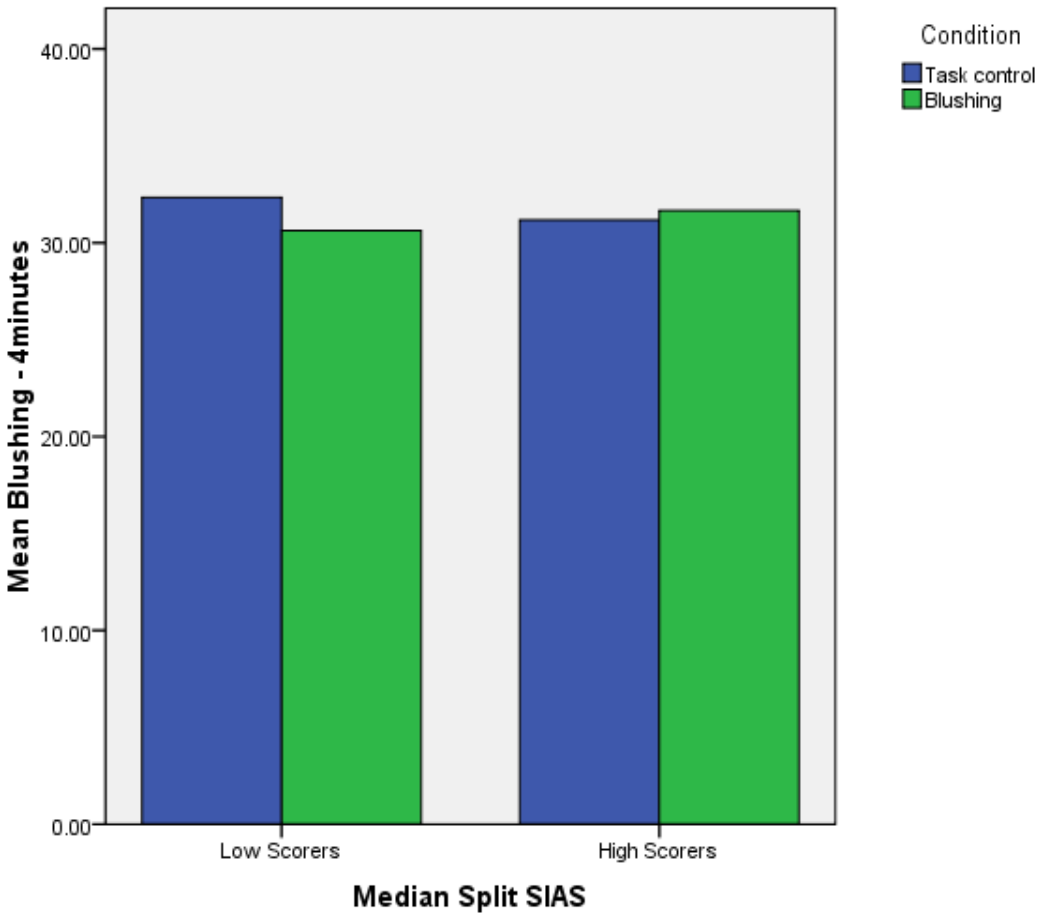

Figure 3: The interaction between subjective blushing temperature, condition and high or low scorers of social interaction anxiety post-interaction.

As demonstrated by comparing Figure 2 and 3, before the speech task high scorers of total social interaction anxiety within the task control condition showed a lower blushing temperature, whereas in the blushing condition the temperature was found

to of heightened. After the speech task, low scorers within the task condition, had a high blushing temperature compared to blushing condition participants who had a much lower temperature of blushing.

If the significance of the interaction of the high and low social interaction anxiety scorers, participant condition and recorded blushing temperatures shown in the two graphs are combined, it shows that low scorers within the task condition have heightened blushing temperatures post-interaction. Low scorers within the blushing condition have decreased blushing temperatures post-interaction. Conversely, high scorers within both conditions have heightened blushing temperature after the interaction.

Lastly, the heart rates recorded from the participant were analysed as the dependent variable with condition, high and low social anxiety interaction scores and the interaction between these three factors. No significant results were found between any of the factors. Heart rate with condition, $F(1, 36) = .055$, $p = .816$, heart rate with high and low social interaction anxiety scores $F(1, 36) = .350$, $p = .558$ and heart rate, condition and high and low social interaction anxiety scores $F(1, 36) = .471$, $p = .497$.

Blushing and self-rated performance

A one-tailed Spearman's correlation was carried out to examine whether there was any correlation between participant's blushing levels and self-performance. The statistical level was set at 0.05. The results showed that there was a significant correlation co-efficient between the first and second blushing temperatures of the participant's at the 0.01 level $r(42) = .71$, $p = .00$, (High degree of positive correlation). There was no other significant correlation coefficients found, the correlation co-efficients between both recorded blushing temperatures and self-performance rating total were insignificant; Real blushing temperature before speech task and self-performance rating, $r(41) = .06$, $p = .37$, Real blushing temperature after speech task and self-performance rating, $r(41) = -.05$, $p = 38$.

Personality, blushing and social anxiety.

A Pearson's two-tailed correlation at the 0.05 statistical significance level was carried out. This was to determine whether any of the big five personality dimensions correlated with levels of social anxiety or blushing propensity in participants. It was

found that total social interaction anxiety and extraversion were significantly and highly negatively correlated at r (38) = -.72, p=.001. This shows that participant's with high extraversion had lower total social interaction scores. Neuroticism was also found to significantly correlate with total social interaction anxiety but positively at r (38) =.49, p=.001. This shows that participant's who scored highly for neuroticism also scored highly on total social interaction anxiety. None of the other personality dimensions significantly correlated with total social interaction anxiety. When total blushing propensity was correlated with the personality dimensions, it was found that it also positively correlated with neuroticism at r (38) =.33, p=.04. This demonstrates how if participants showed high blushing propensity they also scored highly on the neuroticism dimension. No other significant correlations were found.

A simple multiple regression was also carried out predicting total social interaction anxiety scores from the predictor scores. It was statistically significant, F (7, 31) = 8.04, p=.00. The R2=.65 which demonstrates that 65% variance within total social interaction anxiety is accounted for. This shows that not all personality dimensions are predicted significantly with social anxiety and blushing propensity however the two dimensions of neuroticism and extraversion do significantly correlate with either one or both of these variables.

Discussion

The aim of this study is to examine the effect of social anxiety upon physiological and perceived blushing and relation with personality traits. The hypotheses were:

1) Social anxiety is relatively common in university students.

2) The higher the level of social anxiety, the higher the level of blushing.

3) There will be discrepancies between the physiological indicators of blushing and self-report by participants.

4) Participant's blushing levels will be higher the poorer the rating of subjective self-performance.

5) Some of the Big Five personality dimensions will correlate with the levels of social anxiety and blushing propensity found in participants.

The main findings as a result of the present study are summarised and discussed below.

Firstly, it was found that social anxiety is common in university students which supports the first hypothesis. However, the total mean score achieved on the SIAS (Mattick et al., 1998), BPS (Leary et al., 1991), and BFI (John et al., 1991) varied greatly between studies. For Instance, Neto's (1996) study used a Portuguese adaptation of the BFI (Leary et al., 1991) and found an overall mean of 37.7 in a sample of 194. This is in comparison to the present study which found a mean of 8.51 in a sample of 42. This implies that the Portuguese undergraduate sample Neto (1996) used, blush significantly more than the present sample. However, this large difference could be as a result of cultural differences as this study used a Portuguese population and the sample was also a lot larger (N=194) than the present study's sample of N=42.This has been found to be consistent with Heinrech et als. (2006) study which found that social anxiety is related to cultural norms across countries. In Zou et al's (2007) study, the SIAS (Mattick et al., 1998) was used on a sample of 44 high and low blushing-anxious undergraduates. High blushing anxious participants in a self-focused condition achieved a mean of 47.46, whilst in the task-focused condition achieved a mean of 42.27 compared to the low blushing anxious individuals within a self-focused condition, M=12.09 and within the task-focused condition, M=18.91. This shows that high blushing anxious individuals are more anxious in the self-focused condition and there is less difference between groups in the task focused condition. Within the present study, a total social interaction anxiety mean was achieved of 21.50 with a standard deviation of 12.13. Even so, Zou et als. (2007) study achieved much higher means especially for high blushing-anxious participants. Yet, this significant difference could be due to the fact that in Zou et als. (2007) study a much larger sample was first recruited and tested for social interaction anxiety, with only the top and bottom 20% of participants being employed in the small final sample. Hence, this demonstrates individuals suffering from almost no anxiety and extreme social anxiety rather than a generalised view which influences the results. Bunevicius et al (2008) used a shortened version of the BFI (TIPI) developed by Gosling, Rentfrow and Swann, Jnr (2003) on an undergraduate sample of N=411. The mean achieved for extraversion (18.5), was lower than in the present study at M=26.67. This could signify that the present study's samples had

more extroverts. Conscientiousness scored at 21.7 compared to 27.95 respectively which are quite similar but again allude to conscientiousness being higher in the present study's sample. A big difference was found on the agreeableness dimension at 18.1 compared to 34.90, which implies that the present study's sample is more agreeable. Another dimension measured is emotional stability (Neuroticism) which achieved means of 16.5 compared to 23.26, implying the present study's sample is more neurotic and finally openness achieved means of 21.2 compared to 37.62 again showing the present study's sample to be scoring more highly which could show the participant's as being more neurotic.

However, these large differences could be due to other factors. For example, Bunevicius et al. (2008) specifically used medical and humanities undergraduates which may score differently to other groups of students. Although this cannot be compared or tested as the previous two studies (Neto, 1996; Zou et al., 2007) and the present study did not record undergraduate's degree courses. The sample in this case is also a lot larger (N=411) than the present study (N=42) therefore results of the present study may not be comparable to larger scale studies. Lastly, the self-report measure used was a shortened version which would alter the mean of the results as there were fewer items in total.

Another analysis used to assess commonality of social anxiety in university students was to examine the individual items of the SIAS (Mattick & Clarke, 1998). When analysing the highest scores achieved on individual items of the SIAS (Mattick et al., 1998), it was found that the top two scoring items in this sample were item 10 ("I find it easy to think of things to talk about") and item 8 ("I am at ease meeting people at parties"). The other three top scoring items were item 1 ("I get nervous if I have to speak with someone in authority"), item 3 ("I become tense if I have to talk about myself or my feelings") and item 11 ("I worry about expressing myself in case I appear awkward"). When compared to the Mattick et al. (1998) study, testing the scale upon a community sample (N=315), none of the aforementioned scale items which scored highly in the present study scored highly in Mattick et al. (1998) study. This could signify that students are socially anxious about different areas to the general population. However, there are limitations to these findings and other findings as a result of the use of self-report measures. For example, social desirability factors could affect responses given and as the SIAS (Mattick et al.,

1998) items are mostly scaled in the same direction (there are only two reverse-recoded items) this could cause a response bias.

The second hypothesis; the higher the level of social anxiety, the higher the level of blushing propensity was supported. Findings demonstrated that blushing propensity and associated problems with blushing positively correlated with social anxiety. Blushing propensity also positively correlated with blushing problems. This shows that people who blush more have more associated blushing problems which in turn could increase social anxiety. However, this could also show that people that have a higher level of social anxiety thus blush more which causes the associated problems. Due to the nature of the analysis being a correlation, cause and effect cannot be inferred. Previous studies do support these findings, (Gerlach et al. 2001; Bogels et al. 2002; & Zou et al. 2007). Gerlach and his colleagues (2001) found that social phobic individuals had heightened blushing compared to controls. Bogels et al. (2002) also found that participants with high levels of social anxiety had a heightened level of blushing compared to low socially-anxious participants. However, this study lacks ecological validity as hypothetical scripts were used rather than an interaction or speech task. Mirrors were also used in the study which means the participants could observe their level of blushing which could influence the results. Zou et al. (2007) found that high blushing individuals have increased social anxiety in self-focused conditions whilst low blushing individuals have a more consistent level of social anxiety. Although, the sample used was mainly female therefore lacking external validity and no physiological measures were recorded, giving no subjective view. However, there is a lack of clarity within this area, not all people with SADs blush more than those without a disorder. There is also variability within groups, (Gerlach et al., 2001). Inconsistent results have often been found in SAD patients in a heterogeneous group which could lead them to complain more about blushing symptoms or have higher arousability, (Gerlach et al., 2001). This is supported by the fact that individuals, who identify as blushers, have higher cheek temperature than non-blushers (Voncken & Bogels, 2009).

The hypothesis that there will be discrepancies between the physiological indicators of blushing and self-report by participants was supported. Level of social anxiety was found to have no correlation with subjective views of blushing. This does not support previous research (Creed et al, 1998; Voncken et al., 2009). Creed et al. (1998)

found that socially anxious participants were seen by themselves and others as fearful, self-pitying, unassertive, having a lack of social skills and awkward. This could lead to a negative effect upon interaction partners causing an interpersonal cycle of social anxiety. This difference could be explained by Creed at al. (1998) sample size being larger (N=184) compared to the present study (N=44). Voncken et al. (2009) study also found SAD patients with blushing complaints had heightened physiological blushing. Although, this study suffered several equipment failures where data was lost, compromising the data of the study. Heart rate was also not measured in this study. However, these research differences could be due to individuals not estimating their own blushing response well, (Drummond et al., 2007). The use of physiological measurement has also been doubted, Hofmann et al. (2006) found that measurements of heart rate, skin conductance and blushing response could be due to social anxiety or embarrassments which are often hard to distinguish between.

In physiological terms, neither condition nor levels of social anxiety had any effect upon blushing temperature. This supports Edelmann et al. (2002) who found no group differences between experimental and control conditions when measuring physiological measures over 4 tasks. Anderson et al. (2009) also found no physiological differences (heart rate and blood pressure) between adolescents with social phobia and controls. However social phobic participants were aware of any physiological changes and there are potential social implications of this.

However, an interaction between experimental condition, level of social anxiety and blushing temperature was found. Low scorers of social anxiety had higher blushing temperatures pre-interaction when in the blushing condition and higher temperatures when in the task condition post-interaction. High scorers had increased temperatures post-interaction in both conditions. This is supported by Bogels et al. (2002) who found a higher mean blushing level in socially anxious participants, Drummond (2001) who found a higher blushing level in participants with blushing complaints and Hofmann et al. (2006) who reported heightened blushing levels in socially anxious students. However, there is criticism of the Bogels et al. (2002) study as researchers used hypothetical scripts rather than speech or interaction tasks, which causes a lack of ecological validity. These findings imply that within high socially anxious participants, self-focusing does not have an effect on blushing, as in both conditions

blushing temperature heightened post-interaction supporting previous research, (Voncken et al., 2010). Heart rate was also found to have no significant differences between groups in the present study, which is in contrast to Gerlach et al. (2001) and Edelmann et al. (2002). However, in the present study an analogue sample were used compared to clinical samples in the previous studies which could account for the difference as mentioned above.

The fourth hypothesis, that participants' blushing levels will be higher, the poorer the rating of subjective self-performance was not supported. There was no significance found between participant's self-ratings of performance and blushing temperature. This is not supported by previous research such as Boschen et al. (2008) who found social anxiety symptoms correlated with poorer predictions of self-performance. However, a larger sample was used in this study and the experiment was conducted in groups, which could cause higher ratings of social anxiety and poor self-performance. Although, physiological measures have been found to have limitations regarding these types of study. For example, the use of cheek temperature to measure blushing may cloud any results found compared to other studies as cheek temperature has a slow response system (Shearn, Bergman, Hill, Abel, & Hinds, 1990) and cheeks are also bad heat conductors (Guyhart & Hall, 1996). Another explanation for inconsistencies found could be that previous studies don't state when recording physiological measures whether participants changed posture thus this could account for contrasting physiological findings, (Anderson et al., 2009).

Lastly, the hypothesis that some of the big five personality traits will correlate with levels of social anxiety and blushing propensity was supported. Social anxiety was found to have a significant negative correlation with extraversion and a significant positive correlation with neuroticism. This shows how high socially anxious individuals are often low in extraversion and are more neurotic. This means a high socially anxious individual will be introvert, less sociable and outgoing and more likely to experience negative feeling such as anxiety, anger and depression. These findings support the Heiser et al. (2003) study which found participants with social phobia had a positive correlation with introversion and neuroticism. Social phobia has also been found to correlate with low extraversion and high neuroticism supporting Heiser et al. (2003). (Kotov et al., 2010). In the present study a positive correlation was also found between neuroticism and blushing propensity. This also

demonstrates that the more neurotic an individual is the more likely they are to blush. However, this finding lacks supportive research, thus needs to be examined in future research.

Overall, it has been shown that many of the inconsistencies between studies were due to epidemiological samples producing smaller effects than patient samples and inconsistency in methodology. However, there are several limitations of the present study which could affect the applicability of this research to real-world settings. The major limitation of the present study is its representativeness and external validity to the general population. For Instance, the sample of participants used is significantly biased; the sample consisted of all university students, primarily female, single and the majority were aged under 21.The sample also voluntarily contacted the researcher to take part therefore this could imply that the participants involved may deviate from their natural behaviour and thus be less likely to show high levels of social anxiety and display different behaviours compared to people who avoided volunteering. The artificialness of the study also aligns with this limitation. The study was conducted as a laboratory experiment thus may not produce the same results as would an everyday social interaction. Assessment of social anxiety was also only based upon the speech task in a laboratory setting and questionnaires rather than an actual social interaction between two people which increases the artificiality of the study.

Another limitation is the effect of other variables upon the outcome of the study. Many researchers have argued that it is hard to differentiate the effects of social anxiety and embarrassment (Hofmann et al., 2006). This could mean that the anxiety measured could either consist of social interaction anxiety and embarrassment combined, or embarrassment could have a greater unknown affect therefore the results could be influenced by this. This could be demonstrated by the fact that some of the significances found are relatively small, although this could also reflect the small sample used.

Lastly, the materials used to test for social anxiety and personality have also been criticised. For example, Rodenbaugh, Woods and Heimburg (2007) criticised the reverse-scale items of the SIAS as they consistently display weaker relationships throughout studies. Removing these items increases the psychometric performance

of the scale and showed that the reverse scale items actually assess extraversion rather than social anxiety. According to Cabello, Salazar, Irutia, Arias and Guillen (2010) the five factor personality model does not address core constructs of personality, doesn't predict specific behaviours or give a description of possible affects on an individual's personal life and is overly reductionist.

Even so, the present study has implications to the field of anxiety. For example, due to the present study and previous research supporting a correlation between social anxiety and blushing, blushing could be used as a psychophysiological marker of social anxiety within clinical settings. The finding that the more neurotic an individual is the more likely they are to blush and suffer from social anxiety also has treatment implications as the reduction of neuroticism could lead to a reduction in the other factors. However, this needs to be investigated thoroughly first.

Although there are implications to the field of social anxiety as a result of this research, in light of limitations of this study many improvements could still be made. One improvement which could be made is to recruit a larger and varied sample to increase external validity. Another improvement would be to add a social interaction with a confederate to ensure the experiment has increased mundane realism. This could prove whether the findings found in the present study are truly representative. Lastly, physiological measures which are often inconsistent within the research should be recorded more frequently throughout the experimental phase and post-experiment to examine the nature of fluctuations within the physiological measures in both conditions. This could therefore explain why any variation is occurring and theory applied as has been in previous studies to account for this.

Any, future research conducted should focus on accounting for the differences between individuals and their level of social anxiety. For instance, research involving SAD blushers and non-blushers. Research should also explore the effect of blushing within real-life social interactions and the effects of this on the other person and relationships for the individual.

In conclusion, the present study has combined the variables of social anxiety, blushing and personality with subjective self-report and two physiological measures to give an all-encompassing view of factors that influence social anxiety which previous studies have failed to do. This is the first study to achieve this with

interesting results realised. The present study indicates that social anxiety does affect blushing propensity however this is not due to self-focusing or negative self-evaluation as commonly believed. However, the findings propose that there is an interaction between context, blushing temperature and level of social anxiety although, separately these factors have shown not to be significant. This could demonstrate other influences such as personality having a greater affect which is supported by the correlations of neuroticism and extraversion with social anxiety and blushing propensity. Thus future research needs to investigate this association thoroughly.

References

Anderson, E.R., & Hope, D.A. (2009). The relationship among social phobia, objective and perceived physiological reactivity, and anxiety sensitivity in an adolescent population. *Journal of anxiety disorders, 23, 18-26.*

Bogels, S. M., & Reith, W. (1999). Validity of two questionnaires to assess social fears: the Dutch social phobia and anxiety inventory and the fear of blushing, trembling, and sweating-questionnaire. *Journal of psychopathology and behavioural assessment, 21, 51–66.*

Bogels, S.M., & Lamers, C.T.J. (2002). The causal role of self-awareness in blushing- anxious, socially-anxious and social phobic individuals. *Behaviour research and therapy, 40, 1367-1384.*

Bogels, S.M., Rijsemus, W., & De Jong, P.J. (2002). Self-focused attention and social anxiety: The effects of experimentally heightened self-awareness on fear, blushing, cognitions, and social skills. *Cognitive therapy and research, 26 (4), 461-472.*

Bogels, S.M., & Mansell, W. (2004). Attention processes in the maintenance and treatment of social phobia: hypervigilance, avoidance and self-focused attention. *Clinical psychology review, 24 (7), 827-856.*

Boschen, M.J., & Curtis, S. (2008). Investigating a critical evaluation tendency in social anxiety. *Journal of behaviour therapy, 39, 489-496.*

Bunevicius, A., Katkut, A., & Bunevicius, R. (2008). Symptoms of anxiety and depression in medical students and in humanities students: Relationship with big-five personality dimensions and vulnerability to stress. *International journal of social psychiatry, 54 (6), 494-501.*

Cabello,V.E.,Salazar, I.C., Irutia, M.J., Arias, B., & Guillen, J.L. (2010). Relationships between social anxiety and personality traits, styles, and disorders. *Behavioural psychology, 18 (2), 259-276.*

Callejas, M.A. (2009). Blushing: Past, present, and future. *Arch bronconeumoi, 45 (2), 65-67.*

Creed, A.T., & Funder, D.C. (1998). Social Anxiety: from the inside and outside. *Personality and individual differences, 25, 19-33.*

de Jong, P.J., Peters, M.L., De Cremer, D., & Vranken, C. (2002). Blushing after a moral transgression in a prisoner's dilemma game: appeasing or revealing? *European journal of social psychology, 32 (5), 627-644.*

de Jong, P.J., Peters, M.L., & De Cremer, D. (2003). Blushing may signify guilt: Revealing effects of blushing in ambiguous social situations. *Motivation and emotion, 27 (3), 225-249.*

de Jong, P.J., & Peters, M.L. (2005). Do blushing phobics overestimate the undesirable communicative affects of blushing? *Behaviour Research and Therapy, 43, 747-758.*

Dijk, C., & de Jong, P.J. (2009). Fear of blushing: No overestimation of negative anticipated interpersonal effects, but a high-subjective probability of blushing. *Cognitive therapy and research, 33 (1), 59-74.*

Dijk, C., de Jong, P.J., & Peters, M.L. (2009). The remedial value of blushing in the context of transgressions and mishaps. *Emotion, 9 (2), 287-291.*

Dijk, C., Voncken, M.J., & de Jong, P.J. (2009). I blush, therefore I will be judged negatively: Influence of false blush feedback on anticipated others' judgements and facial colouration in high and low blushing-fearfuls. *Behaviour research and therapy, 47, 541-547.*

Drummond, P.D., & Lim, H. (2000). The significance of blushing for fair- and dark-skinned people. *Personality and individual differences, 29, 1123-1132.*

Drummond, P.D. (2001). The effect of true and false feedback on blushing in women. *Personality and individual differences, 30, 1329-1343.*

Drummond, P.D., Camacho, L., Formentin, N., Heffernan, T.D., Williams, F. & Zekas, T.E.(2003) The impact of verbal feedback about blushing on social discomfort and facial blood flow during embarrassing tasks. *Behaviour research and therapy, 41, 413-425.*

Drummond, P.D., Back, K., Harrison, J., Helgadottir, F.D., Lange, B., Lee,C., Leavy, K., Novatscou, C., Orner, A., Pham, H.,Prance, J., Radford, D. & Wheatley,L. (2007) Blushing during social interactions in people with a fear of blushing. *Behaviour research and therapy, 45, 1601-1608.*

Edelmann, R.J. (1990).Chronic blushing, self-consciousness, and social anxiety. *Journal of psychopathology and behavioural assessment, 12 (2), 119-127.*

Edelmann, R.J., & Baker, S.R. (2002). Self-reported and actual physiological responses in social phobia. *British journal of clinical psychology, 41, 1-14.*

Heinrech, N., Rapee, R.M., Alden, L.A., Bogels, S., Hofmann, S.G., Oh, K.J., & Sakano, Y. (2006). Cultural differences in perceived social norms and social anxiety. *Behaviour research and therapy, 44, 1187-1197.*

Heiser, N.A., Turner, S.M. &D.C. Beidel (2003) Shyness: relationship to social phobia and other psychiatric disorders. *Behaviour research and therapy, 41, 2, 209-221.*

Hoffman, S.G., Moscovitch, D.A., & Kim, H. (2006). Autonomic correlates of social anxiety and embarrassment in shy and non-shy individuals. *International Journal of Psychophysiology, 61, 134-142.*

Gerlach, A.L., Wilhelm, F.H., Gruber, K., & Roth, W.T. (2001).Blushing and physiological arousability in social phobia. *Journal of abnormal psychology, 110 (2), 247-258*.

Gosling, S.D., Rentfrow, P.J., & Swann Jnr, W.B. (2003). A very brief measure of the big- five personality domains. Journal of research in personality, 37 (6), 504-528.

Guyton, A.C., & Hall, J.E. (1996). *Textbook of medical physiology.* Philadelphia: W.B. Saunders company.

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *The Big Five Inventory--Versions 4a and 54*. Berkeley, CA: University of California, Berkeley, Institute of Personality and Social Research.

Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking 'big' personality traits to anxiety, depressive, and substance use disorders: A meta-analysis. *Psychological bulletin, 136 (5), 768-821.*

Leary, M.R.(1983). A brief version of the fear of negative evaluation scale. *Personality and social psychology bulletin*, 9, 371-375.

Leary, M.R. & Meadows, S. (1991) Predictors, elicitors and concomitants of social blushing. *Journal of personality and social psychology, 60, 2, 254-262.*

Mannuzza, S., Schneier, F.R., Chapman, T.F., Liebowitz, M.R., Klein, D.F., & Fyer, J.A. (1995). Generalised social phobia: Reliability and validity. *Archives of general psychiatry, 52, 230-237.*

Mattick, R. P., & Clarke, J. C. (1998). Development and validation of measures of social phobia, scrutiny fear and social interaction anxiety. *Behaviour research and therapy*, 36, *455-470.*

McAdams, D.P. (1992). The five-factor model in personality: A critical appraisal. *Journal of personality, 60 (2), 329-361.*

Miers, A.C., Blote, A.W., Bokhorst, C.L., & Westenberg, P.M. (2009). Negative self-evaluations and the relation to performance level in socially anxious children and adolescents. *Behaviour research and therapy, 47, 1043-1049.*

Mulkens, S., de Jong, P.J., Dobbelaar, A. & Bogels, S. (1999) Fear of blushing: fearful preoccupation irrespective of facial colouration. *Behaviour research and therapy, 37, 1119-1128.*

Nasir, R., Zamani, Z.A., Yusooff, F., & Khairudin, R. (2010). Cognitive distortion and depression among juvenile delinquents in Malaysia. *Procedia-Social and behavioural sciences, 5, 272-276.*

Neto, F. (1996) Correlates of social blushing. *Personality and Individual differences, 20, 3, 365-373.*

Peterson, R. A., & Reiss, S. (1992). *Anxiety sensitivity index manual* (2nd ed.). Worthington, OH: International Diagnostic Systems.

Rapee, R. (1995). Psychological factors influencing the affective response to biological challenge procedures in panic disorder. *Journal of Anxiety Disorders, 9, 291-300.*

Rimes, K.A., & Watkins, E. (2005). The effects of self-focused rumination on global negative self-judgements in depression. *Behaviour research and therapy, 43 (12), 1673-1681.*

Rodenbaugh, T.L., Woods, C.M., and Heimburg, R.G. (2007). The reverse of social anxiety is not always the opposite: The reverse-scored items of the social interaction anxiety scale do not belong. *Behaviour therapy, 38, 192-206.*

Shearn, D., Bergman, E., Hill, K., Abel, A., & Hinds, L. (1990). Facial coloration and temperature responses in blushing. *Psychophysiology, 27 (6), 687-693.*

Shimizu, M., Seery, M.D., Weisbuch, M., & Lupien, S.P. (2011). Trait social anxiety and physiological activation: Cardiovascular threat during social interaction. *Personality and social psychology bulletin, 37 (1), 94-106.*

Stein, D.J. & Bouwer, C. (1997) Blushing and social phobia: a neuroethological speculation. *Medical Hypotheses, 49, 101-108.*

Steinberg, L., & Monahan, K.C. (2007). Age differences in resistance to peer influence. *Developmental psychology, 43 (6), 1531-1543.*

Tuschen-Caffier, B., Kuhl, S. & Bender, C. (2011). Cognitive-evaluative features of childhood social anxiety in a performance task. *Journal of behaviour therapy and experimental psychiatry, 42, 233-239.*

Voncken, M.J., & Bogels, S.M. (2008). Social performance deficits in social anxiety disorder: Reality during conversation and biased perception during speech. *Journal of anxiety disorders, 22, 1384-1392.*

Voncken, M.J. & Bogels, S.M. (2009) Physiological blushing in social anxiety disorder patients with and without blushing complaints: Two subtypes? *Biological Psychology, 81, 86-94.*

Voncken, M.J., Dijk, C., De Jong, P.J., & Roelefs, J. (2010). Not self-focused attention but negative beliefs affect poor social performance in social anxiety: An investigation of pathways in the social anxiety-social rejection relationship. *Behaviour research and therapy, 48, 984-991.*

Westenberg, P.M., Drewes, M.J., Goedhart, A.W., Siebelink, B.M., & Treffers, P.D.A. (2004). A developmental analysis of self-reported fears in late childhood through mid-adolescence: Social-evaluative fears on the rise? *Journal of child psychology and psychiatry, 45, 481-495.*

Wild, J., Clark, D.M., Ehlers, A., & McManus, F. (2008). Perception of arousal in social anxiety: Effects of false feedback during a social interaction. *Journal of behaviour therapy, 39, 102-116.*

Zou, J.B., Hudson, J.L., & Rapee, R.M. (2007). The effect of attentional focus on social anxiety. *Behaviour research and therapy, 45, 2326-2333.*