Examining self-report and behavioral measures of attentional control in anxiety disorders

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Abstract

Attention is a fundamental cognitive process which shapes the way an individual sees and interacts with their environment. Anxiety disorders disrupt normal cognitive functioning by interfering with top-down (i.e., goal driven) and bottom-up (i.e., stimulus driven) attentional control processes, such that individuals with high anxiety have distinct attentional biases toward threatening stimuli. Attentional control can be assessed through self-report measures such as the Attentional Control Scale, or through behavioral measures such as a dot-probe task, both of which are used commonly in cognitive research. The current study sought to examine if levels of worry and social anxiety symptoms predict self-reported and behavioral indicators of attentional control abilities, as this relationship has not been well documented in existing literature. Participants completed self-report measures of worry, social anxiety, and attentional control, followed by a modified emotional dot-probe task designed to provide behavioral indicators of attentional control. Results found that those in the high social anxiety group expressed low self-reported attentional control and displayed low responding accuracy across dot-probe trials. No significant relationship was found among worry groups, possibly due to anxiety related deficits in attentional efficiency but not performance. This study expands on current research by documenting the relationship between self-report and behavioral measures of attentional control across levels of anxiety and social anxiety.

Introduction

At any given moment, there is a wealth of information available to be processed within one's surroundings; determining which of these inputs to selectively attend to is instrumental in shaping how an individual sees and interacts with their environment. There are four main components of attention: working memory, competitive selection, top-down control, and bottom-up control (Knudsen, 2007). One's working memory holds a limited amount of information for short periods of time while it is being actively evaluated and manipulated (Baddeley, 2003), and competitive selection is the important process of determining which information is permitted into one's working memory (Knudsen, 2007). Top-down control works in a conscious, goal-driven process which fine tunes one's attention to those inputs which are most relevant to a situation. Conversely, bottom-up control acts in an unconscious, stimulus-driven way to direct attention to the most salient inputs from one's environment, while filtering out sustained or irrelevant stimuli (Knudsen, 2007; Eysenck et al., 2007). Therefore, understanding each of these components and how they work together is fundamental to the study of information processing and attention, particularly in the context of mental illnesses which may cause disruptions to one or more of these systems.

Attentional control theory (Eysenck et al., 2007; Derakshan & Eysenck, 2009; Eysenck & Derakshan, 2011) notes the distinction between top-down and bottom-up control of attention, and states that anxiety interferes with both of these systems by increasing the allocation of attention toward threatening stimuli. As a result, a perceived threat might initially intrude into one's attention due to unconscious biases and thought patterns (i.e., bottom-up processes), then receive additional attention once it has been consciously identified (i.e., top-down control), possibly leading to higher overall levels of worry and the maintenance of anxiety (Grant &

White, 2016; Hirsch & Mathews, 2012). These initial biases toward threat can be present for both task-relevant and task-irrelevant stimuli (Eysenck et al., 2007), and vary by individual and across diagnoses.

Indeed, many different mental illnesses have been associated with various attentional biases. Individuals who suffer from Generalized Anxiety Disorder (GAD) display a bias toward external stimuli that could be perceived as threatening, such as a snake or a gun, as well as toward internal threat cues like elevated heart rate and worrisome thoughts (Bar-Haim et al., 2007; Fox et al., 2007; Grant & White, 2016; Shechner & Bar-Haim, 2016). Social Anxiety Disorder (SAD) is characterized by a bias toward threatening facial expressions, possible rejection cues, and maintaining an internal representation of how oneself appears to others (Hofmann, 2007; Judah et al., 2016; Mueller et al., 2009). Additionally, individuals with depression display a bias toward negative stimuli and thoughts (Mennen et al., 2019), and those who suffer from various substance abuse disorders have a bias toward stimuli related to their drug(s) of abuse, such as an alcoholic drink, lit cigarette, or line of cocaine (Field & Cox, 2008). Such literature seems to indicate that there are a number of broad transdiagnostic attentional biases that can be narrowed specifically for an individual experiencing concerns of a particular disorder. As such, it is critical to better understand the different approaches to measuring the attentional mechanisms underlying these biases.

In addition to self-report measures, there exist several methods for the collection and assessment of behavioral data on attentional control (AC) and biases, including dot-probe tasks (MacLeod et al., 1986), emotional Stroop tasks (Constantine et al., 2001), attention network tasks (ANT; Fan et al., 2002), and visual search tasks (Cohen et al., 1998; Juth et al., 2005). However, prior research has indicated that one’s self-reported AC capabilities oftentimes may

not align with results from a behavioral assessment of AC (Muris et al., 2008; Reinholdt-Dunne et al., 2013). This finding could simply be due to a weak correlation between the tests, as is sometimes seen between self-report and behavioral measures (Dang et al., 2020; Williams et al., 2017), or could perhaps be explained by a discrepancy between one's genuine AC capabilities and one's perception of their AC capabilities.

The Dunning-Kruger effect elaborates on this notion, specifying that self-perception of competence often differs from the truth, and that people are frequently ignorant to their own deficits in knowledge and skills (Dunning, 2011; Mazor & Fleming, 2021). Applied here, this effect could indicate that individuals with deficits in AC, such as those with high levels of anxiety, may believe that they have high control over their attention, when in reality they are subject to a multitude of attentional biases. Dunning (2011) also discusses how the quintessential way for someone to recognize a particular incompetence is to simply eliminate the incompetence. Applied to the realm of attentional deficits, this could have therapeutic implications through methods such as attention training, where an individual is given strategies to counteract their unconscious biases and retrain their attention, which could be an effective intervention regardless of whether or not the patient is aware that they have attentional biases (Bar-Haim, 2010; Eldar & Bar-Haim, 2010; Sass et al., 2017; Schmidt et al., 2009; Schoenmakers et al., 2017).

Despite this wealth of knowledge on the various facets of attention, the relationship between self-report and behavioral measures of attentional control across levels and types of anxiety has not been extensively and directly compared. Therefore, the purpose of the present study was to examine if levels of worry and social anxiety symptoms uniquely predict self-reported and behavioral indicators of attentional control abilities, and to further previous work

suggesting these comparisons. This was done through online administration and subsequent statistical analysis of various self-report questionnaires and behavioral tests related to levels of anxiety symptoms and attentional control. It was expected that individuals with higher levels of anxiety and social anxiety symptoms would self-report high levels of attentional control, but display low levels of attentional control as evidenced by accuracy and reaction times in a dot-probe task.

Methods

Participants

The present sample was comprised of 112 individuals. Participants were recruited primarily from a large Midwestern university through the university's online SONA recruitment system, but also were recruited through online methods (e.g., social media, listservs). Altogether, participants had an average age of 21 years old (*SD* = 4.03), and primarily identified as female (73.3%), Caucasian (78.6%), and as having no Latin or Hispanic origin (91.8%). Participants were grouped into high, moderate, and low worry groups based on self-reported Penn-State Worry Questionnaire scores (PSWQ; Meyer et al., 1990), as well as high and low social anxiety groups based on self-reported Social Interaction Anxiety Scale scores (SIAS; Mattick & Clarke, 1998). All data presented in this paper were collected as part of a larger study examining social inclusion, exclusion, and anxiety (Deros, unpublished Master's thesis), and are reflective of questionnaire data as well as behavioral data collected at baseline.

Measures

The Penn-State Worry Questionnaire (PSWQ; Meyer et al., 1990) is a 16 item self-report measure of the excessive and uncontrollable worry experienced by an individual, often

interpreted as a pre-clinical indicator of worry symptoms associated with Generalized Anxiety Disorder. The response to each item is based on a five point Likert-type scale from 1 (*not at all characteristic of me*) to 5 (*very characteristic of me*). Totals can range from 16-80, with a score below 40 indicating little to no worry, between 40 and 59 indicating moderate levels of worry, and 60 or higher indicating frequent and severe worry.

The Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) is a 20 item self-report measure of one's anxiety response under various social interaction conditions. The response to each presented scenario is recorded using a five point Likert-type scale from 0 (*not at all characteristic of me*) to 4 (*extremely characteristic of me*). Scores can total from 0-80, with a score above 34 indicating high levels of social interaction anxiety.

The Attentional Control Scale (ACS; Derryberry & Reed, 2002) is a 20 item self-report measure used to assess an individual's executive control over their attention. The ACS combines a 9 item measure of attentional focusing and an 11 item measure of attentional shifting (Judah et al., 2014). Responses are recorded on a four point Likert-type scale from 1 (*almost never*) to 4 (*always*), with higher total scores indicating higher levels of attentional control.

Behavioral Attentional Indicators

A version of the attentional dot-probe paradigm (MacLeod et al., 1986; Grafton & MacLeod, 2016; Rodgers et al., 2020) was used to assess behavioral indicators of attentional control, including accuracy of responding as well as efficiency of responding (i.e., reaction times). Image pairings consisted of one negative (angry) facial expression and one neutral facial expression, selected from black-and-white images of Caucasian adult males and females within the Radboud Faces Database (Langner et al., 2010). Each trial began with the presentation of two rectangles for 1000 ms, one of which contained a red box where the participant was instructed to

focus their attention. An anchor probe would then appear inside of the red box for 150 ms. Following this, the facial pairs would appear for 500 ms, one image on the left and one on the right. The screen was then cleared, and a target probe was presented on either the left or right side of the screen. Upon seeing this target probe, the participant was required to use the 'f' and 'j' keys of their computer to indicate whether or not its orientation matched that of the anchor probe which was seen prior to the facial images. Each trial was separated by a 1000 ms break.

After completing a practice block with accuracy feedback, participants completed four subsequent blocks of 32 trials, for a total of 128 trials. Each block consisted of four distinct trial types: engagement-shifting, engagement-focusing, disengagement-shifting, and disengagement-focusing. Engagement trials were those in which the negative face would appear on the opposite side from where the anchor probe had been. Following this, for engagement-shifting trials, the target probe would appear on the same side as the negative face, and for engagement-focusing trials, the target probe would appear on the opposite side from the negative face (the same side as the anchor probe). Disengagement trials were those in which the negative face would appear on the same side as the anchor probe. For disengagement-shifting, the target probe would then appear on the opposite side from the negative face, and for disengagement-focusing, the target probe would appear on the same side as the negative face. To be included in the present analyses, participants needed to have completed the dot-probe task with at least 85% accuracy in line with Rodgers and colleagues (2020). Reaction times were included on trials that were responded to correctly, as well as those trials that did not correspond to outlying response times (i.e., reaction times faster than 250ms, which may reflect unintentional or unpurposeful responding, and

reaction times that fell outside of 1.96 standard deviations from the participant's average reaction times for engagement and disengagement trials).

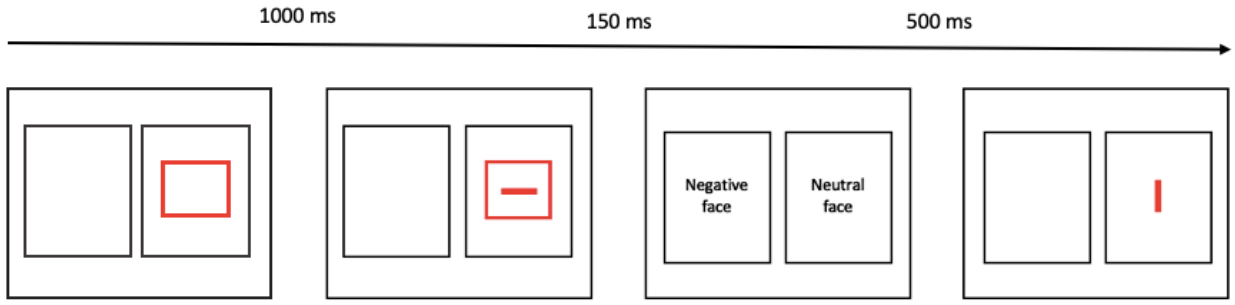

Figure 1. Example of an engagement-focusing trial. Two rectangles appeared for 1000 ms with a red box either in the left or right, then an anchor probe was shown inside of the red box for 150 ms. Next, face pairs were shown (negative and neutral counterbalanced across sides) for 500 ms. Lastly, a target probe appeared, and participants were to indicate whether or not it was of the same orientation as the anchor probe.

Procedure

All measures were completed remotely on each participant's own computer system. Data were collected on the type of computer, browser, keyboard, and mouse used, as well as whether or not the program crashed while running the study. Each participant began the study by answering a series of demographic questions, followed by the PSWQ, SIAS, and ACS self-report questionnaires. The participants then completed a baseline dot-probe, as described above. After completing other tasks consistent with the larger study, participants were debriefed and compensated. Compensation consisted of either receipt of course credit for those recruited from the university, or entry into a random raffle to receive one of ten $20 Amazon gift cards for those who were recruited elsewhere.

Results

A 3 PSWQ Group (High, Moderate, Low Worry) x 2 SIAS Group (High, Low Social Interaction Anxiety) between-subjects multivariate analysis of variance (MANOVA) was

conducted on six dependent variables (ACS score, average reaction time in each dot-probe condition (engagement-shifting, engagement-focusing, disengagement-shifting, disengagement-focusing), total accuracy of dot-probe trials) to evaluate the contributions of the linear combination of self-reported and behavioral indicators of attentional control capabilities across levels of worry and social anxiety symptoms. These data indicated a statistically significant main effect for SIAS Group ($F(6, 99) = 2.36$, $p < .05$, $\eta_p^2 = .125$). Follow-up univariate tests using a Bonferroni correction indicated that for those who reported higher SIAS scores, participants reported lower ACS scores ($M = 49.65$, $SE = 1.87$, $F(1,110) = 6.28$, $p < .05$ $\eta_p^2 = .057$), as well as completed a lower number of correct dot-probe trials overall ($M = 119.19$ trials, $SE = 1.17$, $F(1,110) = 5.02$, $p < .05$ $\eta_p^2 = .046$). No other statistically significant main effects or interactions were observed.

Discussion

The goal of the present report was to examine how levels of worry and social anxiety symptoms may predict self-reported and behavioral indicators of attentional control. Though levels of anxiety and social anxiety did not predict AC capabilities in the ways which were expected, SIAS score was found to predict ACS and behavioral attentional control scores – individuals with higher reported levels of social anxiety symptoms also expressed lower AC, as evidenced by low self-reported ACS score and low responding accuracy across dot-probe trials. These results are in line with prior findings that, with a low ACS score, those with high social anxiety display greater difficulties disengaging attention from social threat cues (Taylor et al., 2016; Reinholdt-Dunne et al., 2009). Taylor and colleagues (2016) additionally examined ACS shifting and focusing factor scores individually, and found that these results were highly robust

for those with a low ACS shifting factor in particular. Future replications should perform analyses on these separate factors to determine their respective relevance to the implications presented in this study.

The results indicate that those with low and high social anxiety have similar abilities in regard to efficiency of responding in attentional tasks, but differences emerge in regard to effectiveness, evidenced by low accuracy of responses for those with high social anxiety. However, the inverse of this effect may explain the lack of results seen pertaining to PSWQ group and AC, as general anxiety related deficits have been found for attentional control efficiency but not effectiveness when under high cognitive load (Shi et al., 2019). This is fitting, as it is known that worry impairs one's efficiency more so than actual performance in GAD (Eysenck et al., 2007). Therefore, an individual with high worry may tend to believe that their performance on a task is poorer than it actually is (Endler et al., 2001), when in reality it only requires more resources for them to complete the task than it would for a non-anxious individual. Another possible reason for the presence of significant SIAS group results, but not PSWQ group results, could be that self-focus and perception of one's personal capabilities plays a much larger role in the mechanisms underlying SAD than in GAD (Hirsch et al., 2004; Judah et al., 2016), which could contribute to possible differences in self-evaluation abilities between worry and social anxiety groups.

It is important to note that behavioral tasks often measure responses to very structured and uncommon stimuli, while self-reports provide a reflection of behavior across real-life unstructured scenarios, which can result in a lack of relationship between self-report and behavioral measures that are intended to assess the same construct (Dang et al., 2020; Barnhart & Buelow, 2017; Williams et al., 2017). This could have occurred with the measures employed

in the present study, as the present study is in line with prior research showing the ACS to have weak correlations with other behavioral measures such as the Attention Network Task (Reinholdt-Dunne et al., 2013) and the Test of Everyday Attention for Children (Muris et al., 2008), although the data collected specifically with regard to children's attentional capabilities may not be fully comparable to the present study, which only examined adults. Further studies should be conducted to ensure that there is a valid and reliable correlation between self-report and behavioral measures of AC, as well as other common constructs for which self-report and behavioral indices are often used interchangeably.

This study was subject to limitations. Placement into high, moderate, or low anxiety and social anxiety groups was determined by PSWQ and SIAS scores rather than by clinical assessment, which could have led to inappropriate grouping and lack of ability to generalize these results to populations with clinically diagnosed GAD and SAD. Additionally, the dot-probe task used in this study utilized only threatening facial stimuli, which may have targeted socially anxious participants' biases more so than those with high worry or generalized anxiety.

In sum, this study used self-reported PSWQ, SIAS, and ACS scores, along with behavioral indicators of AC obtained through accuracy and efficiency data from an emotional dot-probe task, to examine if levels of worry and social anxiety symptoms uniquely predict self-reported and behavioral indicators of AC abilities. The results indicate that individuals with higher levels of social anxiety symptoms view themselves as having low AC capabilities and also show decreased behavioral evidence of AC, evidenced by low dot-probe response accuracy. Future research should be done to see if these results translate to individuals with clinically diagnosed SAD and GAD, or if similar results would be found for other populations with mental illnesses that involve attentional biases, such as depression and substance abuse disorders. The

present results, combined with existing and future research on attentional control, could impact the ways in which we assess and provide treatment for attentional disruptions in anxiety disorders and other common mental illnesses.

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