Controlling the bias: Inhibitory attentional control moderates the association between social anxiety and selective attentional responding to negative social information in children and adolescents

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Abstract

Previous findings suggest that some children and adolescents characterised by elevated social anxiety vulnerability attempt to regulate its debilitating consequences through attentional avoidance of negative social information. To date, however, the dimension of cognitive variability that enables the effective execution of this emotionally beneficial attentional strategy remains unknown. In the current study, we tested the hypothesis that the capacity to effectively attentionally avoid negative social information will be more evident in children and adolescents who exhibit higher levels of inhibitory attentional control, relative to those who display lower levels of inhibitory attentional control. Specifically, we recruited 115 children (aged 11 – 14 years old) from two public schools in Cluj-Napoca, Romania, who varied widely in terms of their social anxiety vulnerability, as assessed by the Social Phobia subscale of the Revised Child Anxiety and Depression Scale. These children completed a novel attentional assessment task designed to provide measures of both inhibitory attentional control, and attentional bias to negative social information. In keeping with the hypothesis under test, our present findings show that the association between social anxiety vulnerability and attentional avoidance of negative social information was indeed more evident in socially anxious children and adolescents with higher levels of inhibitory attentional control. We discuss ways in which future investigators could build upon the present findings to further shed light on the cognitive factors that contribute to vulnerability and resistance to developing social anxiety.

Keywords: attentional bias, attentional control, social anxiety, children and adolescents

In their daily lives, children and adolescents will be confronted with a variety of anxiety-provoking social situations, such as giving a presentation in front of peers, or being asked by a teacher to provide a spontaneous answer to a difficult question. A significant number of children and adolescents display an elevated susceptibility to experience heightened levels of anxiety in such situations (Compton, Nelson, & March, 2000). For these individuals, such anxiety can be very distressing, leading to impairments both in peer relationships (Greco & Morris, 2005) and in school performance (Langley, Bergman, McCracken, & Piacentini, 2004), as well as placing them at heightened risk of being bullied and victimised (Gladstone, Parker, & Malhi, 2006). For many such children, their social anxiety symptoms will largely resolve over time. However, for others, these symptoms will persist into early adulthood and beyond, and may become progressively more severe (Miers, Blote, Rooij, Bokhorst, & Westenberg, 2013). The majority of adults with a diagnosis of Social Anxiety Disorder will have shown signs of this disorder during their childhood and/or adolescence (Otto et al., 2001; McClure & Pine, 2007). In light of the detrimental impacts associated with elevated levels of social anxiety vulnerability in childhood and adolescence, and given the potential for this anxiety to become a lifelong burden, investigators have sought to identify the cognitive factors that contribute to the development of such anxiety vulnerability during these formative years (Hadwin & Field, 2010; Ollendick & Hirshfeld-Becker, 2002). There also has been growing recent interest in identifying the cognitive factors that may serve to protect against the development of severe levels of social anxiety vulnerability, and reduce the potential life trajectory of chronic social anxiety (Iacoviello & Harney, 2015).

One factor repeatedly implicated in vulnerability and resistance to social anxiety is selective attention. Broadly defined, selective attention is a systematic tendency to preferentially

allocate attention towards or away from specific types of stimuli (Puliafico & Kendall, 2006). A number of theorists contend that an attentional bias to negative social information, which operates in an automatic manner, plays a key role in the development and maintenance of elevated social anxiety vulnerability and dysfunction (Clark & Wells, 1995; Rapee & Heimberg, 1997). For example, Rapee and Heimberg propose that a heightened tendency to attentionally monitor the environment for signs of social disapproval or criticism from others, as well as monitor one's own behaviour for evidence of social errors, will contribute to an elevated susceptibility to experience heightened levels of social anxiety. To assess social anxiety-linked patterns of attentional responding to negative social information, investigators commonly have employed the attentional probe task (MacLeod, Mathews, & Tata, 1986). In this task, participants are briefly exposed, usually for 500 ms, to emotionally discrepant stimulus pairs, comprising one negative social stimulus and one non-negative social stimulus. Often these social stimuli are photographs of faces respectively portraying a negative emotional expression (e.g., anger), and a positive emotional expression (e.g., happy). Facial stimuli are very commonly used in research investigating social anxiety-linked attentional bias, as such stimuli are thought to enable a particularly sensitive assessment of biased attentional responding to negative social information (e.g. Bradley et al., 1997; Gilboa-Schechtman et al., 1999). Participants are required, on each trial, to quickly discriminate the identity of a probe that subsequently appears in the locus of either one of the stimulus pair members. The degree to which participants are speeded to discriminate probes appearing in the locus of the socially negative information, relative to probes appearing in the locus of the socially positive information, provides an index of attentional bias to the negative social information. As described below, a number of studies have employed this

task to investigate whether children and adolescents with elevated levels of social anxiety vulnerability selectively attend to negative social information.

Most studies investigating the attentional basis of social anxiety vulnerability in children and adolescents have examined participants diagnosed with one or more paediatric anxiety disorders including, but not limited to, Social Anxiety Disorder, Generalised Anxiety Disorder, Separation Anxiety Disorder, and Specific Phobia. The patterns of attentional bias to negative social information displayed by these clinically anxious participants are compared to non-clinical control participants. The findings have been inconsistent. Using the probe task, under conditions that permit the operation of automatic attentional bias to negative social information, some studies have found that such clinically anxious children and adolescents demonstrate greater attentional bias towards negative social information than do non-clinical control participants (Roy et al., 2008; Seefeldt, Krämer, Tuschen-Caffier, & Heinrichs, 2014; Waters, Henry, Mogg, Bradley, & Pine, 2010). However, this finding has not been consistently replicated across other studies (Salum et al., 2013; Waters, Bradley, & Mogg, 2014). Such inconsistency may reflect differences in the mix of anxiety disorders that have been represented in the participant samples. When studies mix together participants who report elevated levels of social anxiety vulnerability, and those who instead experience other forms of anxious symptomatology, the findings do not permit clear conclusions concerning the attentional characteristics of social anxiety vulnerability in particular.

Recognising this problem, Waters, Mogg, Bradley, and Pine (2011) recruited children and adolescents with a primary diagnosis of only Social Anxiety Disorder, grouped according to severity, together with an age-matched sample of non-clinical control participants. These participants completed an attentional probe task, configured to permit the influence of automatic

attentional processes. An intriguing pattern of results emerged. Specifically, the clinical participants who reported more severe levels of social anxiety exhibited an attentional bias to negative social information compared to control participants, whereas the clinical participants who reported less severe levels of social anxiety exhibited the opposite effect, displaying attentional avoidance of such negative social information compared to controls. On the basis of these findings, Waters et al. (2011) argued that an automatic attentional bias to socially negative information, may contribute to the development of severe social anxiety symptoms in children who suffer clinically debilitating levels of social anxiety, while the ability to over-ride this automatic attentional bias, by adopting the effortful strategy of attentionally avoiding such negative information, may represent an emotional regulation tactic that some people with an elevated disposition to experience social anxiety adopt to attenuate the degree to which their social anxiety symptoms are debilitating in their severity. Such attentional avoidance may reflect a form of 'psychological escape' that enables the individual to reduce some aspects of social threat in the environment without the need to leave the situation (Mansell, Clark, Ehlers, & Chen, 1999).

This idea that strategic attentional avoidance of negative social information may serve to protect people with an elevated disposition to experience social anxiety against the development of clinically debilitating social anxiety symptoms is consistent with findings from research involving non-clinical socially anxious participants. Stirling, Eley, and Clark (2006) used the attentional probe task to assess attentional bias in school-aged children without a diagnosis of Social Anxiety Disorder. They found that higher levels of social anxiety vulnerability were associated with greater attentional bias away from negative social information in this non-clinical cohort. These results are consistent with the idea that individuals who have a heightened

tendency to experience social anxiety may protect against the prospect of this anxiety becoming debilitating, by regulating it through strategic attentional avoidance of negative social information. The fact that some children and adolescents with elevated anxiety vulnerability do not exhibit such attentional avoidance of negative information, and develop severe social anxiety dysfunction at highly debilitating levels, suggests that not all children can successfully regulate emotion by strategically directing attention away from negative social information. Thus, it becomes critically important to identify the dimension of cognitive variability that determines whether children and adolescents with elevated social anxiety vulnerability are able to effectively execute this emotionally beneficial strategy of attentionally avoiding negative social information.

Waters et al. (2011) have argued that one cognitive dimension that plausibly may bear upon socially anxious children and adolescents' capacity to overcome automatic patterns of attentional bias to negative social information, by adopting the strategy of attentionally avoiding such information, is variability in inhibitory attentional control, which reflects the ability to volitionally inhibit attentional responding towards a prepotent stimulus. Individual differences in inhibitory attentional control are typically assessed using experimental tasks that require participants to attend either towards or away from a single neutral stimulus that can appear in either a left or right screen location (Derakshan, Ansari, Hansard, Shoker, & Eysenck, 2009). Attentional distribution is then assessed to reveal individual differences in the degree to which participants are able to fulfill this attentional objective when it does vs. does not require inhibition of an attentional response towards the single neutral stimulus, providing an index of inhibitory attentional control. Waters et al. proposed that, unlike those with lower levels of inhibitory attentional control, socially anxious children and adolescents with higher levels of inhibitory attentional control may be able to rely on this inhibitory attentional control to shift

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attention away from negative social information. There is already some preliminary evidence that anxiety-linked patterns of attentional responding to negative information can be moderated by individual differences in inhibitory attentional control (Lonigan & Vasey, 2009; Susa, Pitica, Benga, & Miclea, 2012). However, not only has this prior research failed to examine socially anxious children and adolescents, but it also has suffered from the major limitation of relying exclusively on self-report questionnaires to assess individual differences in inhibitory attentional control. The limitations of relying on self-report to assess cognitive processes, in general, have been well-documented (c.f., Nisbett Wilson, 1977). And, more specifically, it has been shown that self-report measures of attentional control bear very little relation to objective measures of attentional control (Muris, van der Pennen, Sigmond, Mayer, 2008).

To our knowledge, no research has directly tested Waters et al.'s hypothesis that social anxiety-linked attentional avoidance of negative social information will be more evident in children and adolescents with higher levels of inhibitory attentional control, compared to those with lower levels of inhibitory attentional control. This is the purpose of the current study. In this experiment, children and adolescents who differed widely in terms of their social anxiety vulnerability were exposed to an attentional assessment procedure that comprised two subtasks. One subtask was designed to assess individual differences in inhibitory attentional control, and the other was designed to assess individual differences in attentional bias to negative social information. On both subtasks, every trial began with an initial fixation cue. On those trials designed to assess inhibitory attentional control, this fixation cue contained information that communicated an attentional objective, specifically instructing participants either to attend towards or away from a single neutral image that appeared on either the right or left side of the screen following cue offset. In contrast, on trials designed to assess attentional bias, the fixation

cue communicated no attentional objective, and served only to anchor the attentional focus of participants in the centre of the screen. On these trials, immediately after cue offset a pair of facial images, one on the right and one on the left side of the screen. One of these faces displayed an angry emotional expression and the other a happy emotional expression. On both types of trials, participants were then required to quickly discriminate the identity of a probe that appeared 500 ms later, either on the left or right side of the screen appeared. Probe discrimination latencies obtained from the former subset of trials were used to compute an index of inhibitory attentional control, whereas probe discrimination latencies from the latter subset of trials were used to compute an index of attentional bias to negative social information. Using these measures of inhibitory attentional control and attentional bias, we tested the prediction that the association between social anxiety vulnerability and attentional avoidance of negative social information would be more evident in children and adolescents with higher levels of inhibitory attentional control compared to those with lower levels of inhibitory attentional control.

Method

Participants

Participants were 115 children (50 female), recruited from two public schools in Cluj-Napoca, Romania. These children were enrolled in either the 5th (n = 68) or 7th grade (n = 47). The social anxiety scores of the children, obtained using the Social Phobia subscale of the Revised Child Anxiety and Depression Scale (SP-RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000), ranged from 0 to 27 (M = 7.26, SD = 5.37, Interquartile Range = 7.00), and the age of the children ranged from 11 to 14 years (M = 12.93, SD = 1.06, Interquartile Range = 2.08).

Questionnaire Measure of Social Anxiety Symptoms

The Social Phobia subscale of the Revised Child Anxiety and Depression Scale (SP-RCADS; Chorpita et al., 2000) was used to assess the children's vulnerability to social anxiety. Respondents are required to rate how often they experience each of the nine specified social anxiety symptoms on a scale ranging from 0 (never) to 3 (always). The scores assigned to each item are summed, with higher total scores reflecting higher vulnerability to experience social anxiety symptoms. The Social Phobia subscale RCADS has been shown to have good internal consistency ($\alpha > .80$), test-retest reliability ($r > .70$) and convergent validity ($r > .60$; Chorpita et al., 2000; Chorpita, Moffitt, & Gray, 2005; Ebesutani et al., 2010).

Facial Image Stimuli

Our attentional assessment procedure required two types of stimuli. The first were pairs of photographs showing faces. In each such pair, the two photos were of the same individual, in one image displaying an angry facial expression, and in the other image displaying a happy facial expression. These stimuli were presented in the attentional bias assessment subtask. The second type of stimuli was used in the inhibitory attentional control assessment subtask, and these were single images, each displaying an inverted face with a neutral facial expression. We selected photographs from the FACES database (Ebner, Riediger, & Lindenberger, 2010), which is a standardised set of facial images of individuals who each display a number of different emotional expressions. Specifically, photographs of 48 individuals (24 female) each displaying 3 expressions (anger, positive, and neutral) were chosen for use in this study. For each of the 48 individuals, a face pair comprising the angry and happy facial images was created. All face images were in portrait format, scaled to 340 x 400 pixels, and converted to bitmap format.

Attentional Assessment Procedure

The attentional assessment procedure comprised two subtasks: i. the attentional bias assessment subtask; and ii. the inhibitory attentional control assessment subtask. Ninety-six trials were delivered in each subtask. Across the attentional assessment procedure, trials from each subtask were presented in a random order, with the constraint that, for every consecutive 48 trials, half were attentional bias assessment subtask trials, and the other half were inhibitory attentional control assessment subtask trials. In the following task description, we first outline the features that all trials share in common, regardless of subtask, before describing aspects of trials unique to each subtask.

Trial Structure Common to Both Subtasks. In each subtask, trials began with the presentation of a fixation cue in the centre of the screen. Participants were required to press the spacebar when ready to progress the trial. On the spacebar press, the screen was cleared and a pair of white rectangular outlines (4.8 cm x 6 cm) were presented. The inside edge of one outline was 5 cm to the left of screen centre, and the other 5 cm to the right of screen centre. These outlines demarcated the screen locations in which the stimuli for that trial could appear. After 500 ms a probe was presented within the outline in the left or right screen location, with equal frequency. This probe was a diagonal gradient boundary, either sloping upwards to the left (from the bottom right hand corner of the image) or sloping upwards to the right (from the bottom left hand corner of the image). This probe gradient was created by lightening the image above the gradient by 5% and darkening the image below the gradient by 5%. Participants were required to indicate the orientation of the probe as quickly as possible, by pressing the left arrow key if the probe gradient was sloping to the upwards to the left, or the right arrow if the probe gradient was sloping upwards to the right. The latency and accuracy of this probe discrimination response was

recorded. Following the response, the screen was cleared for 1000 ms, before the next trial began.

Trial Structure Unique to Attentional Bias Assessment Subtask. In the attentional bias assessment subtask, the fixation cue provided no instruction concerning which image the participant should attend to, and was a string of 6 question marks (i.e. "??????"). Participants were required simply to attend to this fixation cue. The fixation cue disappeared and a pair of emotional faces was presented immediately after the space bar was pressed. The face displaying the angry expression appeared in the left and right screen location with equal frequency. The probe that was presented 500 ms later appeared equally often in the locus of the face displaying the angry expression, and in the locus of the face displaying the happy expression. This sequence of events is illustrated in Figure 1. Using the latencies to discriminate probes on these attentional bias assessment subtask trials, we calculated an index of attentional bias to negative information. This index expressed the speeding to discriminate probes in the locus of negative facial images, relative to probes in the locus of positive facial images, and was computed using the following equation:

Index of Attentional Bias to Negative Information = Latency to discriminate probes in locus of positive facial expressions – latency to discriminate probes in locus of negative facial expressions.

A higher score in this index reflects greater attentional preference for negative social information.

[Insert Figure 1 here]

***Trial Structure Unique to Inhibitory Attentional Control Assessment Subtask*.** In the inhibitory attentional control assessment subtask, the central fixation cue always communicated an attentional objective to participants, by instructing them to attend either towards or away from the single face image that would appear on those trials. Thus, in this subtask, the fixation cue was either the word 'ATTEND', or the word "AVOID', with equal probability. When the space bar was pressed the screen was cleared, and a single inverted neutral face image was presented in either the left or right screen location, with equal frequency. The probe that was presented 500 ms later always appeared in the location that participants had been instructed to attend to. This sequence of events is illustrated in Figure 2. When participants succeeded in rapidly shifting attention to the instructed screen locus, prior to probe onset, then they would show fast discrimination of probes. While it can be expected that participants will generally be slower to discriminate probes on those trials that require them to inhibit attention to the presented image, than on trials that instruct them to attend to this stimulus, the magnitude of this slowing will depend on the individual's ability to effectively deploy inhibitory attentional control. Thus, an index that reflects the RT "cost" of exercising inhibitory attentional control can be expressed by computing the magnitude of slowing to discriminate probes on trials that require participants to inhibit attention to the presented image, relative to trials that instruct them to attend to this image, as indicated by the following equation:

Cost of Inhibitory Attentional Control Index = Latency to discriminate probes on "avoid" trials – latency to discriminate probes on "attend" trials.

It is important to note that, because this index expresses the RT cost of exercising inhibitory attentional control, *better* inhibitory attentional control is indicated by *lower* index scores.

[Insert Figure 2 here]

Procedure

The children were permitted to participate in the study only if they provided verbal consent, and also provided a signed parental consent form. The testing session was administered to each participant individually. The participant was first required to complete the Social Phobia subscale of the Revised Child Anxiety and Depression Scale. Following this, the instructions for the attentional assessment procedure were delivered. These instructions emphasised that the participant should respond as quickly as possible, without compromising probe discrimination accuracy. The participant then completed a short practice session, comprising 24 trials (12 of each subtask, with order randomised). The practice trials used 4 faces (2 female) that were not presented in the main assessment task. When it was clear that the task instructions were understood, the participant completed the main attentional assessment procedure, which took between 10 – 15 min.

Results

Prior to computing the index of attentional bias to negative social information, and the index of inhibitory attentional control, as described in the Method section, probe discrimination latencies less than 200ms and greater than 2000ms were discarded, as were those that fell further than 2.58 SD from the participant's mean probe discrimination latency within each experimental condition. The mean probe discrimination latencies observed in each condition were then calculated, and are presented in Table 1. Finally, using these mean probe discrimination latencies, we computed our two attentional indices.

[Insert Table 1 here]

To evaluate the hitherto untested prediction that elevation in social anxiety vulnerability would be more strongly associated with increased attentional avoidance of negative social information in children and adolescents who evidence higher levels of inhibitory attentional control, relative to those with lower levels of inhibitory attentional control, we carried out a moderation analysis using the PROCESS plugin for SPSS (Hayes, 2013). This involved computing the association between the social anxiety scores, obtained from the Social Phobia subscale of the Revised Child Anxiety and Depression Scale (SP-RCADS), and the attentional bias to negative social information index scores. The analysis revealed a significant negative association between the attentional bias index scores and the SP-RCADS scores, t (110) = -2.63, $p < .01$, indicating that, in general, across participants increasing levels of social anxiety vulnerability were associated with increasing attentional avoidance of negative social information. Of most importance to the issue under consideration, the analysis revealed that this association was significantly moderated, as predicted, by the cost of inhibitory attentional control scores, t (110) = 2.29, $p < .05$. This moderation is shown in Figure 3.

[Insert Figure 3 here]

As can be seen from the figure, the nature of this moderation was fully consistent with the hypothesis under test. Specifically, only for participants with lower scores on the cost of inhibitory attentional control index (indicating superior inhibitory attentional control) was it the case that the level of social anxiety, as indicated by SP-RCADS scores, was significantly negatively associated with attentional avoidance of negative social information, as indicated by attentional bias index scores, t (110) = -2.62, $p < .05$[1]. In participants who, instead, obtained

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[1] Although visual inspection of the line of best fit that depicts this association, in Figure 3, may suggest the possibility that, among children and adolescents who exhibited higher levels of

higher scores on this cost of inhibitory attentional control index (indicating inferior inhibitory

attentional control), there was no evidence that levels of social anxiety (SP-RCADS scores) were

associated with attentional avoidance of negative social information, as indexed by attentional

bias scores, $t(110) = .37$, $p = 71$. Indeed, the observed non-significant trend was in the opposite

direction for these children, with increasing levels of social anxiety vulnerability being

associated with (non-significantly) increased attentional vigilance for negative social

information. Thus, supporting the hypothesis put forward by Waters et al. (2011), this pattern of

findings indicates that attentional avoidance of negative social information is more likely to be

observed in socially anxious children and adolescents when these children exhibit higher levels

of inhibitory attentional control.

Discussion

The findings reported in previous research are consistent with the idea that some children

and adolescents characterised by elevated social anxiety vulnerability protect themselves against

the prospect of this anxiety becoming severely debilitating by regulating it through attentional

avoidance of negative social information (Stirling et al., 2006; Waters et al., 2011). In the present

study, we tested the hypothesis put forward by Waters et al. (2011) that the capacity to

effectively execute this emotional regulation strategy will be more evident in children and

adolescents who exhibit higher levels of inhibitory attentional control, relative to those who

display lower levels of inhibitory attentional control. In keeping with this hypothesis, our present

findings demonstrate that the positive association between social anxiety vulnerability and

inhibitory attentional control, those reporting low levels of social anxiety may actually have
displayed significant attentional vigilance for negative social information, this was not the case.
Even for those who fell in the upper 25th percentile of cost of inhibitory attentional control
scores, and the lower 25th percentile of SP-RCADS scores, attentional bias scores did not differ
significantly from zero ($p = .41$).

attentional avoidance of negative social information was indeed more evident in socially anxious children and adolescents who exhibited higher levels of inhibitory attentional control.

Although our findings suggest that children and adolescents with relatively high levels of inhibitory attentional control capability can effectively deploy this control to attentionally avoid negative social information, one limitation of the present study is that we were not able to determine whether this emotion regulation strategy protects against the development of more severe and debilitating levels of social anxiety symptoms. Thus, we believe that future researchers should now seek to directly investigate whether the attentional avoidance of negative social information, exhibited by socially anxious participants with high levels of inhibitory attentional control, does indeed serve this protective function. Longitudinal methodologies could be adopted for this purpose. In an initial session, the present attentional assessment task could be delivered to children characterised by elevated social anxiety vulnerability to identify those individuals who do, and who do not, exhibit attentional avoidance of negative social information (which we would expect to reflect their level of inhibitory attentional control capability). These participants could then be followed-up across time, to test whether those individuals who are able to effectively execute the strategy of attentionally avoiding negative social information are more resistant to the developing clinical social anxiety, and/or come to display more severely disabling social anxiety symptomatology, than is the case for those who do not display the ability to execute this attentional strategy.

In the present study, our high socially anxious participants were not clinically diagnosed with Social Anxiety Disorder. As mentioned, such dysfunctional anxiety is thought to be characterised by patterns of attentional responding to negative information that operate in an automatic manner (Clark & Wells, 1995; Rapee & Heimberg, 1997). Waters et al. (2011) have

demonstrated that children and adolescents who meet diagnostic criterial for Social Anxiety

Disorder, but who are not highly debilitated by this anxiety, exhibit attentional avoidance of

negative social information, consistent with the idea that these individuals are able to

strategically override automatic attentional responding to such information. In contrast, children

and adolescents who meet diagnostic criterial for Social Anxiety Disorder, and who are highly

debilitated by this anxiety, instead exhibit attentional vigilance for negative social information,

suggesting a lack of capacity (or inclination) to engage in the potentially protective attentional

strategy of avoiding such information. While our current results are consistent with the

possibility that these latter individuals may be more severely disabled by their social anxiety

symptoms because they lack the inhibitory attentional control capability necessary to inhibit

automatic attentional vigilance for socially negative information, testing this explanation requires

extending the present research approach to clinically diagnosed socially anxious children and

adolescents. However, an alternative possible explanation for Waters et al.'s findings could be

that the more highly debilitated children and adolescents diagnosed with Social Anxiety Disorder

may not be lacking in inhibitory attentional control capability, but may instead be characterized

by a relatively stronger automatic attentional bias to negative social information than individuals

who are not so severely debilitated, that cannot be fully overridden by inhibitory attentional

control. Future researchers could discriminate the validity of these alternative possibilities by

having participants complete a variant of the present attentional assessment task in which, on

some trials, a secondary load is given to disrupt the strategic execution of attentional control

processes (Sternberg, 1966; van Dillen, Papies, & Hofmann, 2012). The former possibility

predicts that, under this secondary load condition, individuals with Social Anxiety Disorder who

are more severely debilitated by their social anxiety would not differ from those who are less

severely disabled by their social anxiety, with both subsets now displaying equivalent attentional vigilance for threat. In contrast, the latter possibility predicts that, under the secondary load condition, the more severely debilitated socially anxious individuals will display a stronger attentional bias to negative social information than is exhibited by those who are less severely debilitated by their social anxiety.

It is interesting to note that, in the current study, there was no evidence of any significant association between attentional bias to negative social information and social anxiety vulnerability in those children and adolescents who exhibited lower levels of inhibitory attentional control. This presents no challenge to the validity of the hypothesis under test, which was only that the degree to which elevated social anxiety would be characterised by increased attentional avoidance of negative social information would be greater in children and adolescents who exhibit higher levels of inhibitory attentional control. Nevertheless, it is interesting to speculate about why these children with lower levels of inhibitory attentional reflect did not display anxiety-linked vigilance for negative social information. One candidate explanation is that, in these non-clinically anxious children, elevated social anxiety was not characterized by an automatic attentional bias to negative social information. An alternative candidate explanation is that elevated social anxiety was indeed associated with automatic attentional vigilance for such negative information, and these socially anxious children and adolescents who exhibited lower levels of inhibitory attentional control had sufficient attentional control to strategically negate this bias, but not to strategically reverse it as was possible for the children and adolesecents who exhibited higher levels of attentional control. Future investigators could test these alternative candidate explanations by adding, to the present attentional assessment task, a secondary task sufficient to prevent execution of strategic attentional control processes (for example, by

requiring that a lengthy digit string retained in memory during performance of each trial). If an anxiety-linked pattern of automatic attentional vigilance for negative social information does operate in these children, but is being negated by strategic attentional control in the children and adolescents who presently exhibit lower levels of inhibitory attentional control, then the imposition of this secondary task will result in the emergence of anxiety-linked vigilance for this negative information. In contrast, if no anxiety-linked pattern of automatic attentional vigilance for negative social information operates in these non-clinically anxious children, then it will not become evident even when this secondary task is imposed.

The current findings have potentially important implications for researchers seeking to illuminate the ways in which different clinical interventions for social anxiety exert their therapeutic impact. Quite different types of interventions have been found to attenuate the symptoms of clinical social anxiety. For example, cognitive behaviour therapy (CBT) and psychopharmacological agents, such as Selective Serotonin Reuptake Inhibitors (SSRIs), have both proven to be effective approaches (Kodish, Rockhill, & Varley, 2011). However, there is growing evidence that different types of treatment may attenuate social anxiety symptoms through different mechanisms (Boccia, Piccardi, & Guariglia, 2015). One intriguing possibility brought to light by the present findings is that some treatments may remediate social anxiety dysfunction by directly reducing attentional bias to negative social information, while others may bring such therapeutic benefit by enhancing inhibitory attentional control. Future researchers could test this possibility by monitoring attentional bias to negative social information, and inhibitory attentional control, in patients undergoing differing types of intervention, such as CBT or SSRI treatment. This would enable investigators to test the idea that, for some interventions, reduction of attentional bias to negative social information directly mediates therapeutic

improvement in social anxiety symptoms, while for other interventions enhancement of inhibitory attentional control is the primary therapeutic mechanism, with any observed reduction in attentional bias to negative social information representing a secondary consequence of such enhanced attentional control.

The present findings lend credence to the potential benefits of new cognitive technologies designed to therapeutically alleviate social anxiety dysfunction by training procedures that modify selective attention and/or inhibitory attentional control. Investigators have recently obtained promising findings using attentional bias modification (ABM) tasks, which are intended to train target patterns of attentional selectivity. The general approach has involved introducing a systematic contingency into tasks previously used to assess attentional bias, such that task performance will be enhanced by the acquisition of an attentional bias away from a target category of negative information. Such ABM tasks have been shown capable of reducing attentional bias to negative social information, with attendant clinical benefits for social anxiety (Bar-Haim, 2010; Bar-Haim, Morag, & Glickman, 2011; MacLeod & Mathews, 2012). Other researchers have instead developed tasks designed to increase inhibitory attentional control. These have involved extended exposure to tasks, similar to those employed to assess inhibitory attentional control, that place increasingly heavy demands on inhibitory attentional control as practice progresses and control capability improves. There is already evidence that inhibitory attentional control training tasks of this nature can enhance such attentional control, as intended (Volckaert & Noel, 2015). More importantly, there also is growing evidence that such training tasks can deliver emotional benefits (Bomyea & Amir 2011; Hadwin & Richards, 2016; Sari, Koster, Pourtois, & Derakshan, in press). One exciting possibility suggested by the present pattern of results, which could be tested in future research, is that those socially anxious children

and adolescents who exhibit good levels of inhibitory attentional control may benefit more from ABM training than from inhibitory attentional control training, whereas socially anxious children and adolescents who display poor inhibitory attentional control may instead reap more benefits from inhibitory attentional control training than from ABM training.

Of course, it will be important to replicate the present findings before pursuing such future research employing bias modification approaches. In doing so, investigators also could seek to establish the generality of our currently observed findings, by testing children and adolescents from different cultures, ethnicities, and socio-economic groups. For the moment, however, the present findings indicate that the association between social anxiety vulnerability and attentional avoidance of negative social information is more evident in children and adolescents with higher levels of inhibitory attentional control than in those with lower levels of inhibitory attentional control. We hope that the present work serves to stimulate further research into the ways in which bias in selective attention, and variability in inhibitory attentional control, may shape the severity and trajectory of social anxiety vulnerability. We also hope that our suggestions concerning the ways in which future investigators could build upon the present findings will be of value to fellow researchers seeking to illuminate the cognitive factors that contribute to vulnerability and resistance to social anxiety during childhood and adolescence.

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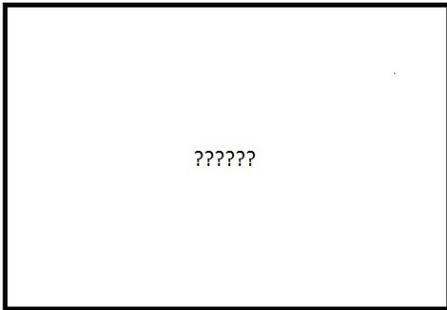
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Table 1. Mean and standard deviation of probe discrimination latencies (in ms) obtained under each experimental condition.

Attentional Bias Assessment Subtask		Inhibitory Attentional Control Assessment Subtask	
Probe Position		*Instruction Type*	
Probe in Angry Image Locus	Probe Opposite Angry Image Locus	Attend Single Image	Avoid Single Image
899.24	889.92	813.98	999.34
(180.22)	(176.84)	(187.50)	(202.56)

Figure 1. Illustrative example of sequence of events on an attentional bias assessment subtask trial (probe in locus of angry face member of emotional image pair).
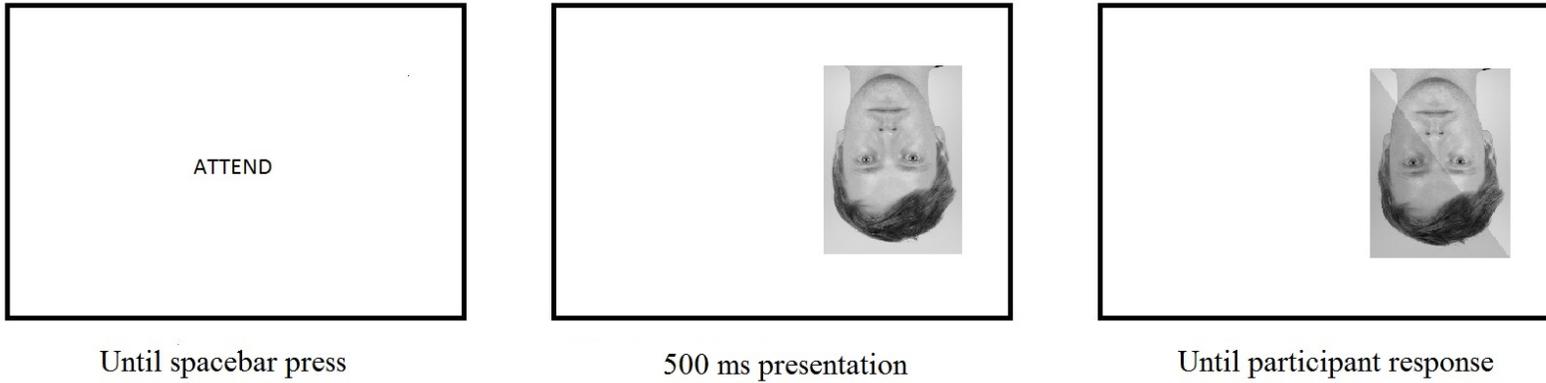
ATTEND		
Until spacebar press	500 ms presentation	Until participant response

Figure 2. Illustrative example of sequence of events on an inhibitory attentional control assessment subtask trial (attend single image).
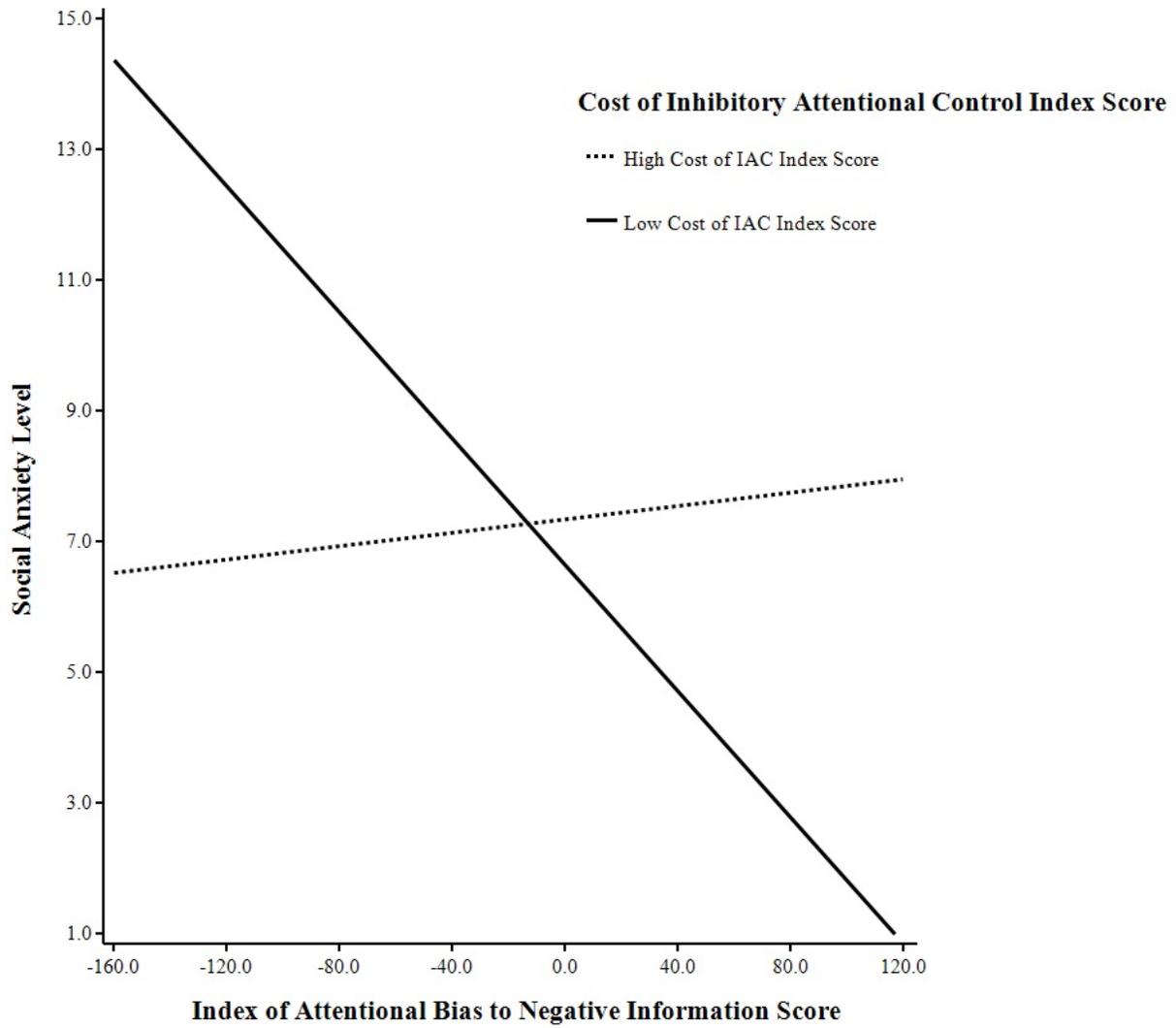
Figure 3. Interaction of attentional bias to negative social information index scores x cost of inhibitory attentional control index scores in predicting SP-RCADS scores.