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ATTENTION BIAS MODIFICATION TREATMENT FOR SOCIAL ANXIETY: AVOIDANCE OR EXPOSURE TO THREATENING FACES;
THE ROLE OF PRE-EXISTING ATTENTION BIAS AND STATE ANXIETY

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KLAVDIA NEOPHYTOY

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DEPARTMENT OF PSYCHOLOGY

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THE ROLE OF PRE-EXISTING ATTENTIONAL BIAS AND STATE ANXIETY

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DECLARATION OF DOCTORAL CANDIDATE

The present Doctoral Dissertation was submitted in partial fulfilment of the requirements for the Degree of Doctor of Philosophy of the University of Cyprus. It is a product of original work of my own, unless otherwise mentioned through references, notes or any other statements.

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ABSTRACT (ΠΕΡΙΛΗΨΗ)

Η παρούσα έρευνα αποτελείται από 2 πειράματα τα οποία έχουν ως σκοπό την μελέτη της αποτελεσματικότητας της παρέμβασης Μετατροπής Μεροληψιών Προσοχής (Attention Bias Modification Treatment; ABMT) σε άτομα με κοινωνικό άγχος (ΚΑ). Επιπρόσθετα, η παρούσα μελέτη στοχεύει να διερευνήσει τις συνθήκες κάτω από τις οποιες η θεραπεία είναι αποτελεσματική εξετάζωντας τον ρόλο του είδους των προϋπαρχουσών μεροληψιών προσοχής (pre-existing attention bias; P-AB) και των επιπέδων άγχους κάτω από συνθήκες άγχους (state anxiety). Στο πρώτο πείραμα έγινε τυχαία κατανομή 60 συμμετεχόντων σε εκπαίδευση μακριά από απειλητικά πρόσωπα και στην ομάδα εικονικής παρέμβασης. Οι συμμετέχοντες έλαβαν 8 εκπαιδεύσεις (2 φορές την εβδομάδα για 3 εβδομάδες) με το έργο dot-probe. ΑΒ αξιολογήθηκαν με το συγκεκριμένο έργο και ΚΑ με ερωτηματολόγια αυτό-αναφοράς και κλινική συνέντευξη αντίστοιχα πριν, αμέσως μετά και 6 μήνες μετά την θεραπεία. Τα αποτελέσματα έδειξαν έλλειψη αποτελεσματικότητας της ABMT. Επίσης, P-AB και state anxiety δεν τροποποιούσαν την αποτελεσματικότητα της θεραπείας. Το δεύτερο πείραμα αποτελείτο από 82 συμμετέχοντες που κατανεμήθηκαν τυχαία στα 2 είδη εκπαίδευσης που αναφέρθηκαν και σε μια τρίτη ομάδα εκπαίδευσης προς τα απειλητικά ερεθίσματα (για να ληφθεί υπόψη ο ρόλος της αποφυγής των απειλητικών ερεθισμάτων). Οι συμμετέχοντες έλαβαν 4 εκπαιδεύσεις (2 φορές την εβδομάδα για 2 εβδομάδες) με το έργο dot-probe. ΑΒ αξιολογήθηκαν με μέτρηση των οφθαλοκινήσεων και το Posner task και τα επίπεδα ΚΑ με ερωτηματολόγια αυτό-αναφοράς, συμπεριφορικές και ψυχοφυσιολογικές μετρήσεις πριν και μετά την εκπαίδευση. Τόσο η αξιολόγηση όσο και η εκπαίδευση έγιναν κάτω από συνθήκες άγχους (επερχόμενη ομιλία). Τα αποτελέσματα έδειξαν και πάλι μη αποτελεσματικότητα, και επίσης ούτε οι P-AB ή state anxiety levels τροποποιούσαν την αποτελεσματικότητα ABMT. Η μοναδική εξαίρεση αφορούσε την μείωση του συνοφρυώματος (ένδειξη αρνητικού συναισθήματος) που παρουσιάστηκε στην συνθηκη εκπαίδευσης μακριά από απειλητικά ερεθίσματα και στα άτομα που παρουσιάζουν τον τύπο μεροληψιών αποφυγής της προσοχής. Το συγκεκριμένο αποτέλεσμα φαίνεται να μην συνδέεται με αλλαγές στις μεροληψίες προσοχής. Μία πιθανή εξήγηση θα μπορούσε να είναι ότι αποτελεί προιόν μάθησης των ατόμων να παρουσιάζουν παρόμοιες εκφράσεις προσώπου με αυτές που εκπαιδεύτηκαν να εστιάζουν την προσοχή τους. Αν και ο συγκεκριμένος μηχανισμός λειτουργίας είναι δύσκολο να διασαφηνιστεί, φαίνεται το συγκεκριμένο αποτέλεσμα να αποτελεί ένα θετικό αποτέλεσμα. Συγκεκριμένα, πιθανόν να συνδέεται με αύξηση ανοχής των κοινωνικών καταστάσεων στα άτομα και να μειώνει τις πιθανότητες αντιλαμβανόμενης λήψης

αρνητικής ανατροφοδότησης. Το τελευταίο άρθρο της διατριβής κοιτάζει την σχέση μεταξύ του χαρακτηριστικού αυτοσυνειδησίας (self-consciousness; SCS) και είδους ΑΒ, όπως και τον μεσολαβητικό ρόλο των επιπέδων ΚΑ. Τα αποτελέσματα έδειξαν ότι η ιδιωτική αυτοσυνειδησία σε συνδυασμό σε χαμηλά επίπεδα ΚΑ προβλέπει αποφυγή, ενώ σε ψηλά επίπεδα ΚΑ προβλέπει εγρήγορση κάτω από μη στρεσογόνο γεγονός (πείραμα 1). Κάτω από στρεσογόνες συνθήκες (πείραμα 2) δεν βρέθηκε κάποια σχέση μεταξύ των συγκεκριμένων μεταβλητών. Τα συγκεκριμένα αποτελέσματα αναμενεται να συνεισφέρουν στην δημιουργία αποτελεσματικότερων πρωτοκόλλων ABMT. Τα γενικότερα αποτελέσματα δείχνουν τις ανάγκες για περαιτέρω διερεύνηση: 1) του ρόλου των διαφορετικών τύπων ΑΒ στην αποτελεσματικότητα της παρέμβασης ABMT, 2) του ρόλου εκπαίδευσης μακριά από απειλητικά ερεθίσματα και της μείωσης του αρνητικού συναισθήματος, 3) της σχέσης μεταξύ SCS και είδους ΑΒ.

ABSTRACT

The current study is comprised of 2 experiments aiming to examine Attention Bias Modification Treatment (ABMT) effectiveness in socially anxious individuals and inform future studies by examining pre-existing attention bias (P-AB) and state anxiety levels as moderators of treatment effectiveness. For the first experiment, 60 participants were randomly allocated to a training away from threat condition and a placebo group. Participants received 8 training sessions (2 times for 3 weeks) with the dot-probe task. AB and SA levels were measured with the dot-probe task and self-report as well as clinician measures respectively at pre-, post-treatment and 6 months follow-up showing no effectiveness of ABMT. In addition, P-AB and state anxiety levels did not moderate treatment effectiveness. The second experiment was comprised of 82 participants who were randomly assigned to training away from threat, towards threat (aiming to examine the role of attentional avoidance) and placebo group. Participants received 4 training sessions (2 times for 2 weeks) with dot-probe task. AB were measured with eye-tracking and the Posner task and SA levels with self-report, behavioural and physiological measures at pre- and post-treatment. Both assessment and training were done under a stressor (upcoming video-recorder speech). Results showed again no effectiveness of ABMT. In addition, P-AB and state anxiety levels did not moderate treatment effectiveness. The only exception was Corrugator reduction (index of negative affect) in training away from threat group only for avoiders. This result was not related to attention bias modification and its mechanism seems to be unclear based on the current results. One possible explanation could be that this is a learning effect of a similar face reaction that participants were trained to focus to. Apart from the potential mechanism this result is considered as useful as it might help socially anxious individuals to tolerate more social situation and reduces the possibilities of perceived negative feedback from others which in turn will increase their anxiety levels. The last article examines the relationship between the trait-characteristic of self-consciousness (SCS) and AB type and the moderating role of SA levels. Results showed that private SCS predicts attentional avoidance under low SA levels and vigilance under high SA levels under no stressor (experiment 1). Under stressor (experiment 2) no relationship was found between SCS, SA levels and AB type. This result can inform ABMT aiming in the creation of more effective protocols. Directions for future research are suggested that include: 1) examining more the role of different AB types in the modification treatment, 2) examining the potential role of training away from threat in the reduction of negative affect, 3) examining further the role of SCS and AB types.

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CHAPTER 1: LITERATURE REVIEW

Social anxiety disorder (SAD) is defined as an intense fear that a person has of the possibility to be negatively evaluated by others in social situations (APA, 2013). It is a common disorder with prevalence rates at about 13.3% (Barlow & Durand, 2000). Specifically, it has been classified as the 2nd most common psychological disorder in the general US population (Kessler et al., 2005) and the second most common anxiety disorder (Wittchen et al., 2011) in Europe. It is related to low quality of life (Stein & Kean, 2000), and is a risk factor for the development of additional psychopathology (Schneier et al., 1992). Social anxiety incurs economic costs such as work absenteeism and to a lesser extent, high health care utilization (Stuhldreher et al., 2014).

According to DSM-5, individuals who present with SAD can be divided into two main groups with the first demonstrating primarily performing in public or public speaking fears and the second demonstrating general social fears. The majority group can be characterized by both performance and social fears. Both general social and specific performance fears have similar age of onset, family history and sociodemographic characteristic (Kessler, Stein, & Berglund, 2014). Nonetheless, general social fears are more persistent, have a greater impact in people's lives as well as higher comorbidity with other disorders (Kessler, Stein, & Berglund, 2014). Generally, untreated social anxiety can have a chronic and disabling course (Dewit, Ogborne, Offord, & MacDonald, 1999).

Cognitive-behavioral therapy is an evidence-based treatment for this disorder and is considered the most effective for adults (Albano & DiBartolo, 2007). Nonetheless, a high percentage of people with SAD do not seek treatment (Brown, Wells, & Magnus, 2006). Specifically, people who suffer from anxiety disorders do not seek treatment for some of the following reasons: a) the stigmatization that they perceive may accompany traditional treatment, b) biased beliefs about therapists, c) lack of willingness to discuss personal issues with strangers, d) concern about confidentiality, e) lack of knowledge about appropriate services and their effectiveness and f) practical obstacles e.g. distance (Griffiths & Christensen, 2007; Taylor & Luce, 2003; Titov et al., 2008). People with SAD, additionally do not seek treatment for reasons that also relate to characteristics of social anxiety, for instance avoidance and fear of negative evaluation (Cuijpers & Schuurmans, 2007). For these reasons, there is a need for novel treatments, which can be

widely acceptable by people who suffer from anxiety disorders and specifically SAD (Amir et al., 2009).

One promising new treatment, which seems to overcome many of the above-mentioned obstacles is attention bias modification treatment (ABMT). Attention bias modification is a computerized intervention and therefore it eliminates sharing personal information or confidential worries or fear that the person is going to be negatively evaluated by the therapist. In addition, it requires no or limited therapist involvement and it is a very short time intervention, therefore making it easily accessible to socially anxious individuals. In addition, if enough support of this training effectiveness and the context which its effectiveness is associated, e.g. clinic or patient's place, is received in the future, this can lead to even more easily access of it.

Attention Bias Modification treatment aims to reduce anxiety by changing attentional processes, specifically changing where the socially anxious individuals focus their attention, i.e. away from angry faces. A threatening facial expression is considered as an ancient signal of submissiveness through evolutionary history (Öhman, 1986), and therefore fearful, especially by individuals with social anxiety. As anxious in general, SAD involves attention biases (AB), i.e .preferential allocation of attention to greater AB disorder congruent stimuli in comparison with disorder incongruent stimuli (Pergamin-Hight, Naim, Bakermans-Kranenburg, van Ijzendoorn, & Bar-Haim, 2015). i.e. threatening faces.

Attention, the process that ABMT targets, refers to a cognitive process, which allows the brain to prioritize specific stimuli for elaboration (Shechner et al., 2012). AB in anxiety are attentional processes which interfere with normal stimulus processing. They can include hypervigilance to threat, attentional avoidance, and difficulty of disengagement from threat. *Hypervigilance* is the 'preference' of allocation of attention to threat relative to neutral stimuli (Bogels & Mansell, 2004; Cisler & Koster, 2010). This means that the threatening stimuli can be identified easier and quicker than neutral (Cisler, Bacon, & Williams, 2009). *Attentional avoidance* of threatening stimuli is considered to happen when attention is directed away from threatening stimuli. Finally, *difficulty of disengagement* from threat refers to a delayed withdrawal of attention from a threatening stimulus towards a different task because of its ability to hold attention (Clarke, MacLeod, & Guastella, 2013).

Theoretical models of attention biases in anxiety

Many studies highlight the importance of attention biases in the etiology and maintenance of anxiety disorders (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg &

van IJzendoorn, 2007). In addition, all theoretical models of anxiety refer to AB as important processes which maintain it (see table 1). Nevertheless, existing theoretical models give differential emphasis to specific attentional processes and how these interact with anxiety levels. The majority of models on the role of attention processes in anxiety, focus on the facilitated attention to threat that characterizes anxious individuals, which is based on the perceived importance or the threatening value of the stimulus, in interaction with state anxiety and levels of trait anxiety (Bar-Haim et al., 2007; Eysenck, Derakshan, Santos, & Calvo, 2007; Matthews & Mackintosh, 1998; Mogg & Bradley, 1998; Ohman, 1996; Williams, Watts, MacLeod, & Mathews, 1988). Examples of such models are the following:

Firstly, *Attentional Control Theory* by Eysenck et al., (2007), suggests that anxiety in normal populations affects their central executive functions, interrupting the function of two central processes which are related to attentional control: inhibition and shifting. Inhibition is the ability to regulate automatic responses and shifting refers to the ability to switch attention between tasks. In both cases, anxious individuals present an increase of stimulus driven attention which means that both external, e.g. threatening task irrelevant distractors and internal stimuli, e.g. worrisome thoughts, that are perceived as threatening can distract them during a task. This distraction presents itself in the form of disrupted inhibition, which means that individuals cannot easily demonstrate top-down regulatory control (or goal driven attention). In addition, anxiety disrupts shifting, meaning that the impact of the bottom-up process of stimulus driven attention is increased, resulting in decreased ability to voluntarily shift attention from one task to another. These disruptions lead to both difficulty of disengagement from a distracting stimulus, e.g. a threat during a task as well as at the facilitated detection of threat. Both difficulty of disengagement from and vigilance to threat are observed in anxiety disorders as well as in typical populations with increased trait anxiety.

Secondly, according to Bar-Haim et al., (2007), a *Multidimensional Model* can explain the process of attentional biases in high-trait anxiety and in the anxiety disorders. First, an evaluation of the incoming stimulus takes place by a preattentive threat evaluation system (PTES). Through this system anxious individuals automatically evaluate a benign or mildly threatening stimulus as highly threatening. However, if the stimulus is evaluated as low threatening then one pursues one's current task and ignores the negative stimulus. If the stimulus is evaluated as high threatening, according to a resource allocation system (RAS) anxious individuals interrupt their ongoing activity, orient their attention to the

threat and become physiologically aroused. Biases appear in the RAS of anxious individuals because they tend to allocate attention even to mild threats. After this initial evaluation, the guided threat evaluation system (GTES) is activated. At this stage, anxious individuals assess the context of threat, compare the present threat with prior memory and learning and assess the available coping resources. If the outcome of GTES is different form PTES, which means that the threat is evaluated as low, then there is a relaxation of the alert state, which allows one to ignore the stimulus and orient attention to current goals. However, anxious individuals may consciously perceive a stimulus as highly threatening even when prior learning or coping skills indicate the contrary. Even the realization that their anxiety is irrational based on the context cannot easily lead to the termination of physiological arousal due to deficiencies in the overriding mechanism (RAS), which would have relaxed the alert state in non-anxious individuals once the stimulus was evaluated as non-threatening. If the outcome of GTES is the same with PTES, i.e. the stimulus is evaluated as high threatening, a state of high anxiety will result.

In addition, some models refer to the presence of attentional avoidance instead of or in addition to vigilance to threat (Mogg & Bradley, 1998); William et al., 1988). An example of a model, which describes attentional avoidance is that of Williams et al., (1988). According to this model, anxious individuals without very high levels of anxiety instead of presenting vigilance to threat (presented when anxiety is high), present attentional avoidance. The model does not clarify how this is possible and how it is affected by the level of threat value, e.g. if individuals can avoid even a highly threatening stimulus. In addition, Mogg & Bradley, (1998), while they acknowledge that attentional bias is the typical process in anxiety, suggest that at lower levels of anxiety or when faced with a moderate threatening stimulus individuals may present attentional avoidance.

Another dimension of attentional biases addressed in the different models is the degree of automaticity of attention bias processes. Generally, some of the models propose that attentional biases are automatic in nature (e.g. William et al., 1988), while others propose that they are both automatic and voluntary/strategic (Matthews & Mackintosh, 1998; Ohman, 1996). As an example, the Cognitive Model of Anxiety (Beck & Clark, 1997), which has at times been applied to SAD, suggests that anxiety is characterized by biases during the initial registration of a threat stimulus, which is called automatic threat registration. Specifically, there is an early detection of threat, which operates outside awareness. In addition, the primal threat mode is activated, which aims to minimize threat. This mechanism, which entails the recognition of negative information, is composed of

both automatic and strategic processes (e.g. initial stimulus appraisal, hypervigilance for threat, and negative automatic thoughts), even if it is largely stimulus-driven. After initial perception, anxious individuals present with a schema-driven processing of threat (secondary elaboration), which is slow and effortful rather than automatic and includes reappraisal of the stimulus context and the individual's coping strategies. Therefore, according to this model early facilitated attention to threat is automatic but later difficulty of disengagement from threat is strategic.

In contrast, Wells & Mathews, (1994) propose a *Self-regulatory Executive Function Model* emphasizing the role of top-down processes in attention control and attention biases. They suggest that individuals are guided towards threat by self-knowledge, as well as voluntary goals and beliefs. According to them, attentional bias is the result of a voluntary threat-monitoring strategy. Anxiety involves the conscious perception of a stimulus as threatening and monitoring of the threat in order to create a coping plan. The content of the coping plan differs between anxiety disorders and individuals depending on one's personal concerns. Therefore, the model proposes that attentional biases result from anxious individuals' ingrained beliefs that it is important to monitor threat.

Models specific to social anxiety

The *Cognitive-Behavioral model of anxiety* of Rapee & Heimberg, (1997), which explains how social anxiety is maintained, claims that individuals with social anxiety fear negative evaluation but also assign special importance to others' positive appraisal of themselves. During a social interaction, they create a mental image of themselves of how they may appear to others. This mental image contains information from long-term memory (e.g. prior experiences), from internal interoceptive cues (e.g. somatic symptoms, thoughts) as well as external information (e.g. audience feedback). Specifically, attentional resources are allocated to features of self which are perceived as negative and related to the social situation as well as to external threats e.g. audience feedback such as frowns and signs of boredom. The same time socially anxious individuals try to make predictions about the norms or standards that their appearance needs to have in a given social situation. If the image that they create for themselves does not meet the requirements of how the person thinks that he/she should appear to others (appearance and behavior), one infers that there is an increased possibility for negative evaluation. This elicits more anxiety with physiological, cognitive and behavioral symptoms. At this point anxiety influences back the mental representation of self as seen by the audience and therefore the cycle is renewed.

Similarly, the *Cognitive model of social phobia* (Clark & Wells, 1995) suggests that socially anxious individuals interpret a social situation as threatening due to their previous negative experiences. Based on these, they believe that they are going to behave in a non-acceptable way and this will have negative consequences, e.g. rejection from others. Therefore, when entering a social situation, they present cognitive, somatic, affective and behavioral defensive changes, which are probably inherited from humans' evolutionary past. These changes become further signals of danger and maintain or exaggerate anxiety. With regards to attentional processes this model refers to the importance of self-focused attention and avoidance of eye-contact (which could be interpreted as attentional avoidance). Attention is assumed to turn inwards for example towards ones' increased heart rate, and self-evaluative thoughts; self-focused attention in turn, interferes with the ability to process social cues, which may lead to errors in social behavior, become interpreted as failure and create new negative learning experiences that perpetuate social anxiety.

Summary

Taking the above discussion into consideration, it seems that existing models do not fully converge with regards to their assumptions about the specific AB that maintain anxiety. Nonetheless, a common element is the presence of vigilance to threatening stimuli at least during early stages of processing. To the contrary other elements are more controversial; difficulty in disengaging from threat is presented only in the models of Beck & Clark, 1997, Eysenck et al., 2007, Bar-Haim et al., 2007, and Rapee & Heimberg, 1997. Attentional focus to internal stimuli in addition to external stimuli is included only in the model of Beck & Clark, (1997), Eysenck et al., (2007), Rapee & Heimberg, (1997), and Clark & Wells, (1997). In contrast the model of Williams, Watts, MacLeod, & Mathews, (1988), refers to attentional avoidance in low trait anxious individuals, similar to Mogg & Bradley, (1998; 2016).

Many studies support the overall standpoint of these models, finding that anxious individuals have threat-related biases (Bar-Haim et al., 2007), including socially anxious individuals. In general, it seems well documented that individuals with SAD pay particular attention to social threatening information, including signs of disapproval from others (Amir et al., 2009; Pishyar, Harris, & Menzies, 2004) as well as to internal threat stimuli (Bögels & Mansell, 2004). There is also some evidence for the less common AB proposed by the models above, that individuals with social anxiety have difficulty with disengagement of their attention from social threat (Amir, Elias, Klumpp, & Przeworski, 2003) and present attentional avoidance (Mogg, Bradley, Miles, & Dixon, 2004). Further

research is required to reconcile these models and clarify the stages of processing during which each type of AB takes place.

Empirical Evidence for Attentional biases in Anxiety

Cognitive models receive support from empirical studies demonstrating that attentional biases (AB) have a central role in the development and maintenance of anxiety disorders (Beard, 2011). The existence of AB is a robust result, found with a variety of tasks and across anxiety disorders (Cisler & Koster, 2010). A recent meta-analysis of 172 studies with different stimuli, populations and tasks found that AB is a robust phenomenon with a low to medium effect size of d=.45 (Bar-Haim et al., 2007). However, it is unclear what exactly the attention processes are that contribute to these AB effects and which one or which combination of processes plays the most important role in the maintenance of social anxiety.

Attentional Vigilance and Attentional Disengagement

Hypervigilance is the 'preference' for the allocation of attention to threatening relative to neutral stimuli (Bogels & Mansell, 2004; Cisler & Koster, 2010). This means that the threatening stimuli can be identified more easily and quickly than the neutral (Cisler, Bacon, & Williams, 2009). Many studies found hypervigilance to threat in both clinical and sub-clinical samples with anxiety (Mogg & Bradley, 2002). Hypervigilance has also been identified when the threatening stimuli were presented for very brief, pre-conscious intervals in anxious individuals (Mathews & MacLeod, 1986; Mogg & Bradley, 2002**)**.

According to some studies vigilance to threat is a normal adaptive process, which can be found in both high and low anxious individuals. That is, early, preferential attention to a threatening stimulus during the first 200ms is the typical, adaptive response found in the general population (Moriya & Tanno, 2011). After this initial vigilance, however, in anxious individuals there is a difficulty with disengagement from the threatening stimulus, which typically appears after 200ms of stimulus presence. This process refers to a delayed withdrawal of attention from a threatening stimulus because of its ability to hold attention (Clarke, MacLeod, & Guastella, 2013). Some studies have actually suggested that this is the only attentional bias that anxious individuals present (Amir et al., 2003; Fox, Russo, Bowles, & Dutton, 2001). Therefore, when it comes to anxiety, it is important to study the attentional processes which take place after the localization of threat (Clarke, MacLeod, & Guastella, 2013). According to Derryberry & Reed, (2002), the difficulty in disengagement is moderated by attentional control, which is a capacity that helps the effortful regulation

of attention –involving focus or shifting - in comparison to less voluntary, automatic early pre-attentive reactions of attention (Derryberry & Rothbart, 1988). Specifically, trait anxious individuals high in attentional control could more easily disengage their attention from threat at 500ms than trait anxious individuals with poor attentional control (Derryberry & Reed, 2002).

Typically, results indicating difficulty in disengagement from threat in SAD have been found using the Posner task (e.g. Amir et al., 2003). Using this task socially anxious individuals were found to be significantly slower to find the invalidly cued targets (when the probe appeared in a different location than the cue) than controls only when the probe followed a social threat word (Amir et al., 2003). The use of other tasks has also led to similar conclusions. In Moriya & Tanno, (2011), socially anxious individuals were found to show difficulty with disengagement from threat after 300ms of stimulus presentation. According to the authors, this effect was related specifically to social anxiety and not to comorbid depression or trait anxiety. In addition, Schofield, Johnson, Inhoff, & Coles (2012) using eye-tracking during a dot-probe task, found that high social anxiety was related to attention towards emotional faces, instead of neutral faces, at later stages of stimulus presentation. They found evidence for difficulty with disengagement from threatening faces only, showing that after the initial vigilance, socially anxious individuals could not stop allocating their attention towards the threatening pictures.

Vigilance-avoidance hypothesis

Although results showing hypervigilance to threat in anxiety have been replicated many times, they are by no means unequivocal. Some studies have found the opposite results, showing attentional avoidance where attention is directed away from threatening stimuli among anxious participants. More specifically, in some studies, anxious people in addition to allocation of attention towards threat during early stages of processing, tended to direct their attention to the opposite location from where the threatening stimuli where previously presented at later stages of stimulus presentation (Cisler, Bacon, & Williams, 2009; Cisler & Koster, 2010; Mogg, Bradley, Miles, & Dixon, 2004). For example, Koster, Verschuere, Crombez, & Van Damme, (2005) found that high trait anxious individuals present vigilance to threat at 100ms in comparison with low trait anxious individuals. However, at 200ms and 500ms they presented a stronger tendency to avoid the threatening stimulus. Looking at the literature more broadly, it is not clearly evident when exactly (exact ms) individuals show vigilance and when they show avoidance (Boettcher et al., 2013). Studies generally show that at a shorter duration of threat presentation e.g. 500ms,

trait anxious individuals typically present with vigilance to threat, however at longer stimulus durations e.g. 1500ms or longer they are typically found to present with avoidance (e.g. Koster, Verschuere, Crombez, & Van Damme, 2005; Koster et al., 2006). The same stands for socially anxious individuals (e.g. Garner, Mogg, & Bradley, 2006; Mansell, Clark, Ehlers, and Chen, 1999; Mühlberger, Wieser, & Pauli, 2008). Therefore, attentional avoidance is an additional essential component to consider in attention bias studies.

Given these findings, the vigilance-avoidance hypothesis was proposed (Mogg et al., 2004) in an effort to reconcile existing evidence regarding AB in SAD. The vigilance-avoidance model suggests that attention is initially and preconsciously allocated to searching for threat e.g. a frowning face and once the danger is detected it is subsequently avoided (Mogg et al., 2004). This conclusion is based on a review of the time-frames used in attention bias (dot-probe) studies described above. In accordance with Clark & Wells, (1995) the vigilance-avoidance model also suggests that avoidance during conscious stages of processing may help perpetuate anxiety, as it may result in decreased habituation or reappraisal of danger, leading to increased anxiety and interpretation of the situation as more threatening than it actually is (Bögels & Mansell, 2004).

Moderating Factors: State anxiety

The vigilance-avoidance hypothesis acknowledges that avoidance is an important attention process which needs to be taken into consideration for AB research. It is worth examining if methodological differences between studies which have found that high SAD individuals show attention vigilance versus attention avoidance can explain the different results. Most of the studies which concluded that people with SAD show attentional avoidance appear to have some specific methodological characteristics compared to those that did not find avoidance effects, such as the presence of a state anxiety manipulation, for example a public speaking stressor (Bögels & Mansell, 2004; Shechner et al., 2012).

State anxiety is the result of the presentation of a stimulus that produces anxiety (Pacheco-Unguetti, Acosta, Callejas, & Lupiáñez, 2010), during which individuals respond with the feeling of tension, worry, activation of the autonomous nervous system and avoidant or safety behaviors (Fountoulakis et al., 2006). To the contrary, trait anxiety is related to individual differences in anxiety proneness as a personality trait, or a 'predisposition' which leads to tendency for elevated anxiety as a response to a stressful situation. Trait anxiety is a characteristic of socially anxious individuals, but the presence

of state anxiety during the experimental situation may be required for certain AB effects to appear (Bögels & Mansell, 2004).

To examine this possibility, Garner, Mogg, & Bradley, (2006), used eye tracking with high and low socially anxious individuals, who completed the dot-probe task, after they were informed them that they would give a public speech. Participants with high social anxiety showed initial vigilance for all emotional faces regardless of expression, but they also spent less time looking at the emotional faces in comparison with low socially anxious participants, showing evidence of avoidance. Moreover, Mühlberger, Wieser, & Pauli (2008) obtained a similar result using virtual happy or angry faces while informing half of the participants that they were going to give a talk after task completion. In the state anxiety condition, after the initial vigilance, higher social anxiety was related to avoidance of both types of emotional faces. Similar results were obtained by others who also used a state stressor (e.g. Garner, Mogg, & Bradley, 2006; Helfinstein, White, Bar-Haim, & Fox, 2008; Mansell, Clark, Ehlers, and Chen, 1999).

In sum, social anxiety may interact with presence or absence of state anxiety to change attentional processing. Social anxiety may be related to avoidance (Amir et al., 1996), if state stress is also present. However, in the absence of state anxiety the AB that socially anxious individuals present appears to be vigilance to threat. Therefore, future research needs to examine this potential moderator of AB effects (Cisler & Koster, 2010).

Attention bias tasks

Apart from potential moderators such as state anxiety, the variety of tasks used in attention bias studies may have contributed to discrepant results as well. A description of the most common tasks used in attention bias research is presented below:

A common task used in SAD research on attention biases is the visual search task (e.g., Öhman, Flykt, & Esteves, 2001; Rinck, Becker, Kellermann, & Roth, 2003), which assesses spatial distribution of attention. Participants have to identify a target stimulus which is placed among various distracting stimuli. For example, a threatening word is located among several neutral words. Likewise, a neutral word can be located among various threatening words, or a threatening face among neutral faces etc. In general, the visual search task tends to assess both vigilance to threat and difficulty of disengagement. Facilitated attention is measured as the faster responses to detect a threat which is located among neutral stimuli compared to detecting a neutral stimulus which is located among neutral stimuli. Difficulty in disengagement is measured as less time to detect a neutral stimulus which is located among threatening stimuli in comparison to detect a threatening

one which is located among neutral stimuli. The reason is because the threatening one tends to capture the attention (Cisler, Bacon, & Williams, 2009**;** Cisler & Koster, 2010).

In addition, during the Spatial Cueing Task, also known as the Posner task (Fox et al., 2001; Posner, 1980), participants need to focus on a specific point between two rectangles. Next, one of the rectangles is highlighted or a threatening stimulus is displayed in it, followed by a target stimulus in the same position as one of the two rectangles. Individuals need to identify the rectangle in which the target stimulus was shown. AB is believed to exist when individuals are faster giving the correct response to rectangles where a threat rather than a neutral stimulus was previously presented. Difficulty of disengagement from threat is considered to exist when individuals give slower responses at invalidly cued responses (the stimulus was not presented after the threatening cue) relative to valid cues (the stimulus is presented after the threatening cue) (Cisler & Koster, 2010). Thus, the Posner paradigm allows for an investigation of both facilitated attention towards threat and a difficulty in disengagement from threat (Cisler, Bacon, & Williams, 2009).

The modified Stroop task (Stroop, 1935) presents threatening or neutral words in different colours. The participant has to name the colour of the word ignoring the word meaning. If the individual needs more time to name the colour of the threatening in comparison with the neutral word, this is an indication of AB as it is assumed that the emotional aspects of the stimulus grasped and maintained attention (Cisler & Koster, 2010). However, the slower reaction times to threatening words can be also explained through a) the emotional reactions that these words could cause, b) cognitive avoidance of the word, c) mental preoccupation with the word (Bogels & Mansell, 2004). Because of these reasons the emotional Stroop has been criticized as an ineffective task to establish the presence of attention biases in anxiety.

In order to overcome these disadvantages MacLeod et al. (1986), designed the dot-probe paradigm which is the most common task in the field of attentional biases. Moreover, it has several advantages over the Stroop test. Specifically, the presentation of the two stimuli, threatening and neutral, is simultaneous and therefore it measures selective attention to one of them. In addition, attentional biases are measured with regards to reaction time therefore reducing the effect of mental preoccupation. Furthermore, it allows for the measurement of attentional avoidance (Bogels & Mansell, 2004*)* by measuring reaction time to a threatening vs neutral stimulus, which in SAD research typically involves faces. This corrects for some limitations of the Stroop task when used in SAD research, as measuring attention by presenting words may lack ecological validity because

in reality it is the facial expression of others which is considered as a primary social threat in social anxiety.

Many studies demonstrated the validity of this task in distinguishing anxious from non-anxious individuals (e.g. Bar-Haim et al., 2007). However, some studies questioned its split-half and test-retest reliability (Schmukle, 2005; between -.22 and +.32 and Staugaard, 2009 between -.58 and +.37) in non-clinical samples. Two recent studies (Price et al., 2014; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014) also found low reliabilities of this task. However, Bar-Haim et al., (2010) found larger split half reliability coefficients (r=+.45), which may be related to the sample which was clinical in contrast to the above-mentioned studies. Similarly, high reliabilities were found by Waechter & Stolz, (2015) and Enock, Hofmann, & McNally, (2014) using a smart-phone delivery of the dot-probe task, which however have still been criticized as being relatively low (Waechter & Stolz, 2015) or potentially acceptable (Rodebaugh et al., 2016).

Given the mentioned limitations of these traditional paradigms, one may consider that the best way to measure attentional biases is by measuring attention overtly. Therefore, it has been suggested that the most accurate way of AB assessment involves eye-tracking which assesses the exact position of the eye gaze as well as eye movement during stimulus presentation (Bogels & Mansell, 2004). Recent studies using eye tracking typically present pairs of emotional and neutral stimuli e.g. angry and neutral faces to participants, while continuously recording eye movement. It provides direct and continuous measure of visual attention and is a measure with ecological validity, because it is not based on individuals' subjective experience (Bogels & Mansell, 2004; Chen, Clarke, MacLeod & Guastella, 2012; Schofield, Johnson, Inhoff, & Coles, 2012).

Eye-tracking can give four different types of attentional indices. The two most common types are considered the proportion of first fixations (Calvo & Avero 2005; Garner et al. 2006) and the latency of first fixations (Garner et al. 2006), which assume that looking more often and more quickly an emotional stimulus instead of a neutral stimulus is an indicator of facilitated attention to threat. Other indices of AB based on eye-movements are the proportion of fixation frequencies (Gamble and Rapee 2010; Hermans, Vansteenwegen & Eelen 1999) and the proportion of viewing time on the emotional stimulus in comparison with the neutral stimulus (Calvo and Avero 2005; Schofield et al. 2012). These two indices are averaged with regards to the whole time of stimulus presentation e.g. 5000ms and/or are divided into time intervals e.g. 1000ms in order to examine how attention changes over time (Waechter et al., 2014).

The first study which looked at the reliability of eye-tracking found that the reliability estimate of the first fixation indices was low (first 1500ms Waechter et al., 2014). This was partially explained by the participants' tendency to look first at the top image irrespective of its emotional valence. The proportion of fixation frequencies and the proportion of viewing time of the emotional stimulus in comparison with the neutral stimulus over the 5000ms time duration had very high reliability (α>.8). Nonetheless, eye-tracking has not been used very often due to technical issues which make it a time-consuming procedure. Improvements in this technology make it more likely to be used in future studies (Jacob & Karn, 2003).

In conclusion, to-date, most studies have used the above-mentioned tasks in an effort to establish the existence of attention biases in anxiety disorders in general and SAD in particular. The majority of studies used the dot-probe task, and a smaller number of earlier studies used the Stroop task. A different way of measuring AB is eye-tracking, which measures attention overtly. Even if it is considered the best way to measure AB it has been used much less frequently than the other tasks.

Attention Bias Modification Treatment (ABMT): effectiveness and mechanisms of change

An attention bias modification protocol aims at reducing one of the components of attention bias and specifically vigilance towards threat. This aims to result in anxiety reduction through changing the automatic focus of attention that anxious individuals have toward threat. The most commonly used task to modify attention biases is the dot-probe task. When this task is used to modify AB, a symbol is presented after a pair of faces (angry and neutral face) and participants are asked to find the right symbol. In attention bias modification the presentation of response targets is consistently after neutral and not threat stimuli. Therefore, participants are trained not to allocate their attention to threat e.g. an angry face but instead to neutral stimuli. This leads to implicit learning through repetition of trials (Bar-Haim, 2010). To-date there seem to be mixed results about the effectiveness of attention bias modification treatment in social anxiety, although meta-analytic findings tend to support its efficacy for anxiety.

A meta-analysis of 12 randomized controlled trials of attention bias modification treatment with regards to anxiety (1 study with socially anxious, 2 studies with generalized anxious participants and mostly subclinical or nonclinical anxious participants) concluded that this treatment has a significant medium effect size, which is a promising result (*d* =

0.61; Hakamata et al., 2010). Linetzky, Pergamin-Hight, Pine, & Bar-Haim, (2015) in a recent review found that ABM is an efficient treatment for anxiety disorders. Clinician ratings for the intervention group in comparison to the control group showed improved levels of anxiety due to the treatment with a significant medium effect size (d = 0.42). Nonetheless, the effect on self-reported measures of anxiety was not significant. According to the researchers, clinician-administered measures may be more sensitive to changes than self-reported measures. In addition, there was a considerable reduction of attention bias, as measured by RT, in the training than in the placebo group, which receives equal prompting towards the neutral and threat stimulus.

Similar results were obtained in a meta-analysis by Price et al., (2016) in a sample with anxiety disorders (76% SAD, 13% generalized anxiety and 11% other anxiety disorders) who also found that young age (<37 years), receiving training in the laboratory and relying on clinician assessment were significant moderators of treatment effectiveness. Lastly, Dennison (2018) found that ABMT is efficient for reducing anxiety in comparison to no-treatment control groups. In addition, this recent meta-analysis showed that age, method of training (computer vs internet) and location of training were not statistically significant moderators of treatment effectiveness, in contrast to Price et al. With regards to clinical vs subclinical symptoms, it seems that these groups do not differ for between group analyses, but clinical population gives larger effect sizes for within-groups analyses.

These meta-analytic studies are based on several findings supporting ABMT for anxiety, which included some of the following examples of studies. After an ABMT intervention in the context of an RCT, (Schmidt, Richey, Buckner, & Timpano, 2009) more patients in the intervention group no longer met the diagnostic criteria (72%) for SAD, unlike those in the control group (11%) according to a clinician administered measure, but not self-report measures. Treatment gains were maintained four months later. Amir et al., (2009), found that people in an AB intervention group had reduced attention bias as well as social anxiety symptoms following treatment. Half of the participants no longer met diagnostic criteria for SAD in comparison to 14% in the control group. This was confirmed by an independent assessor and self-report questionnaires, even though post-treatment SPAI scores still exceeded the clinical cut-off. It is worth mentioning that in this study the attention bias assessment task, which was based on the Posner paradigm, was different from the intervention task which was the typical dot-probe task.

Amir et al., (2008) found that a single session of attention bias modification treatment was effective at reducing attention bias from pre-to post assessment, specifically

with regards to public speaking anxiety. However, the treatment and placebo groups did not differ on self-reported anxiety symptoms at post-treatment. Nonetheless, participants in the intervention group coped better at a speech task than the control group. Li, Tan, Oian, &Liu, (2008) found that people in the intervention group had reduced attentional bias and symptoms of social anxiety, measured using the Social Interaction Anxiety Scale (SIAS), in comparison to the control group. No differences were found on the Social Phobia Scale (SPS) and Fear of Negative Evaluation Scale (FNE). It should be noted that this study differs methodologically due to the fact that the intervention group was trained to focus on positive pictures instead of neutral.

Two very recent studies found that ABMT was superior to the control condition as well as to cognitive bias modification treatment with regards to symptoms reduction (Naim, Kivity, Bar-Haim, & Huppert, 2018). Also, ABMT in combination with cognitive behavioural group therapy (CBGT) had better symptoms reduction in clinician measures in comparison with CBGT alone. Once more, group differences were not found in self-report measure and AB levels (Lazarov et al., 2018).

There is a small number of studies that did not support ABMT as an effective treatment, but their negative results may be explainable by methodological limitations. Bunnell, Beidel, & Mesa, (2013) found no differences between the groups with regards to self-report, clinician interview and behavioral measures of social anxiety following the AB treatment. However, this study did not assess pre and post intervention attentional biases and the sample was small. Maoz et al., (2013) examined the efficacy of a subliminal AB intervention on a student sample, finding no improvement on attentional biases or self-reported social anxiety. The negative result may be due to the low baseline attentional biases of the sample and the idiosyncratic task used.

Therefore, an additional moderator of ABMT effectiveness may be the level of attentional biases at pre-treatment. It seems that participants with limited attentional biases toward threat do not present with gains in comparison to control groups (Amir, Taylor, & Donohue, 2011). In support of this conclusion, an fMRI study in combination with the usage of a dot-probe task found that socially anxious individuals who presented greater left amygdala activation at baseline, which is related to vigilance to threat, had greater symptom reduction post-treatment regardless of the training condition (Britton et al., 2014). Finally, level of pre-training bias appears to be a strong indicator of treatment outcome (Aday & Carlson, 2017).

Another potential moderator of treatment effectiveness is the modality of treatment delivery. Studies that investigated ABMT effectiveness delivered through the internet, i.e. without therapist contact (e.g. Boettcher et al., 2013; Boettcher, Berger, & Renneberg, 2012; Carlbring et al., 2012; Neubauer et al., 2013), showed less effectiveness that when the treatment was delivered in a clinic, perhaps because effectiveness in the context of the clinic was mostly found on clinician-administered measures. It is also possible that the fact that participants in the internet-based intervention were in the relaxing context of their home is related to the absence of a stress condition, to the degree that state anxiety may be an additional moderator of effectiveness. Based on a similar rationale, Kuckertz et al., (2014), compared internet based AMBT from Carlbring et al., (2012) with internet-based delivery of ABMT plus activation of state anxiety e.g. making a difficult phone call, to internet-delivered Cognitive Behavioral Therapy (iCBT). Results showed that internet ABMT+state anxiety was superior to internet ABMT-only and the same as iCBT. Higher initial attention bias was also a significant moderator of anxiety reduction.

Mechanisms of change:

Despite the effectiveness of ABMT, it is still not entirely clear why it works and what exactly changes when anxious individuals are trained to attend to neutral stimuli. To answer this question, three studies (Boettcher et al., 2013; Heeren et al., 2011; Klumpp & Amir, 2010) compared the typical ABMT training away from threat or training towards a positive stimulus with training towards threat in an effort to investigate the mechanism of change behind ABMT. Klumpp & Amir, (2010) proposed that if ABMT works via training disengagement from threat then there would be a reduction of anxiety only in the attention training away from threat condition. However, an alternative mechanism of action would be supported if there was a decrease in anxiety in both the training toward and away from threat conditions. This alternative mechanism of change could be increased attentional control as described by Derryberry & Reed, (2002) that is the ability to direct attentional resources toward a targeted goal such as probe detection. Results showed that there were differences in trait anxiety post task, however all participants –except those in the control condition- presented with a similar reduction in anxiety during a public speaking task, supporting increases in attentional control regulation as the mechanism of change. Nonetheless, this research did not use any task which measures attentional control before and after training in order to examine its role.

Heeren et al., (2011) hypothesised that if there is reduction of anxiety in all conditions (training toward threat, training towards positive stimuli) then this can be

explained as an improvement of attentional control, based on the same logic as Klumpp & Amir, (2010). However, a reduction of anxiety in the group that was trained to attend to the positive stimuli only would mean that ABMT has to do with improvement in attentional biases processes by reducing vigilance towards threat or difficulty disengagement from it through training towards a non-threatening stimulus. Results showed that the group trained to attend to positive stimuli only presented reduced levels of self-reported social anxiety post-treatment and 2 weeks later. According to researchers these results reflect changes to the attentional biases.

Even though Heeren et al., (2011) found reduction of anxiety only in the group that was trained towards positive stimuli, Boettcher et al., (2013) found a significant reduction of anxiety in the group that was trained towards threat. Although Klumpp & Amir, (2010) explained this finding in their study as changes in attentional control, a different explanation may be the reduction of attentional avoidance due to repeated exposure to threat. This was the rationale of the Boettcher et al., (2013) study; however, participants did not present any changes in attentional biases at post- treatment. It is worth mentioning that in this study participants had not presented any pre-treatment AB, which maybe related to the non-significant AB change. The treatment modality also, (internet-delivered) may have affected the results.

In sum, although ABMT studies overall show significant treatment effectiveness some studies found no effect of this treatment, (e.g. Boettcher et al., 2013; Bunnell, Beidel, & Mesa, 2013). Different results may be due to a number of moderators that should be taken into consideration, including the level of attentional biases at baseline and the modality of treatment delivery which it is probably related to the levels of state anxiety present. Most importantly, it is unclear how ABMT works and specifically which attentional processes change after the intervention. Proposed mechanisms of ABMT effectiveness are vigilance to threat and difficulty of disengagement from threat. Moreover, effects of this treatment may be related with exposure towards threatening faces and reductions in attentional avoidance, a hypothesis that needs to be studied. Conclusions regarding changes in attentional avoidance through ABMT seem to be premature and results are currently inconsistent.

Given the mixed findings regarding the effectiveness of ABMT for SAD, it remains an important question if ABMT is effective for this condition and if it is, for whom is it effective and for whom is it not and under what circumstances. In the present study, two experiments were conducted aiming to examine the effect of attention bias modification

treatment in individuals with social anxiety, taking into consideration previous results. Secondly these studies aimed to examine potential moderators of ABMT effectiveness: 1) type of pre-existing AB e.g. if specific training works better for specific AB type and 2) state anxiety levels, e.g. if specific training works better under state anxiety, based on the above-mentioned literature. The first Experiment compared training attention to be directed away from threat with a placebo treatment. The second Experiment added a third group of training towards threat (i.e. exposure), investigating if extinguishing attentional avoidance can also affect anxiety levels. For this specific experiment, AB and SA assessment as well as AB training were done under a stressor, in order to examine potential effects of state anxiety manipulation. In addition, participants were assessed behaviourally as well as physiologically aiming to fill the gap in previous studies, which mostly measured SA changes with clinician or self-report measures. Finally, the last chapter uses data from both Experiments aiming to predict AB type (vigilance or avoidance) based on the individual characteristic of self-consciousness and SA levels. This specific chapter can inform ABMT and help in the creation of more effective protocols e.g. if specific sub-group of individuals need different kind of training. Therefore, the current thesis is comprised by 3 more chapters which are presented below.

CHAPTER 2

Experiment 1: Effectiveness of Attention Bias Modification treatment in socially anxious undergraduate students

Abstract: According to cognitive models, attention to social threat is one of the principles that maintain social anxiety. In fact, individuals with social anxiety are known to show attention biases to threat stimuli, although there is inconsistency in the literature with regards to the type of attentional biases they present. The present study, aims to examine the effect of attention bias modification treatment in individuals with social anxiety, taking into consideration previous results, which present a mixed picture as to its effectiveness. A comparison of training attention to be directed away from threat with a placebo treatment was undertaken. In addition, moderators of treatment effectiveness were investigated, specifically pre-intervention attentional biases and state anxiety, a novel contribution of this study. Sixty-eight socially anxious individuals were randomly allocated to the 2 groups. A structured interview and self-report assessment were completed at pre-treatment, post-treatment and 6 months follow-up. Results showed no difference from pre to post treatment with regards to AB, self-report and clinician measures of anxiety based on training group. In addition, pre-existing AB and state anxiety levels did not moderate treatment effectiveness. The same non-statistically significant results were found at follow-up stage. However, half of the participants presented limited AB at pre-treatment level and from those who presented AB half of them presented vigilance and half of them avoidance. Therefore, ABMT may not have been effective because of not severely enough baseline AB or because training towards neutral faces is not efficient for participants who present attentional avoidance.

Introduction

Social anxiety disorder (SAD) is highly prevalent with rates to be around 13.3% (Barlow & Durand, 2000), and has been classified as the 2nd most common psychological disorder both in the general US population (Kessler et al., 2005) as well as in Europe (Wittchen et al., 2011). It is generally a risk factor for the development of additional psychopathology and therefore it has high comorbidity with other disorders e.g. anxiety disorders and depression (Fehm, Beesdo, Jacobi, & Fiedler, 2008; Schneier et al., 1992). In addition, it is related to low quality of life as socially anxious individuals tend to avoid social situations (Stein & Kean, 2000). For this reason, social anxiety is related to

economic costs such as work absenteeism and to a lesser extent, high health care utilization (Stuhldreher et al., 2014).

Generally, receiving no treatment for social anxiety can lead to a chronic and disabling course of the disorder (Dewit, Ogborne, Offord, & MacDonald, 1999). Cognitive-behavioral therapy is an evidence-based treatment for this disorder and is the most effective treatment for adults (Albano & DiBartolo, 2007). However, a high percentage of people with SAD do not seek treatment (Brown, Wells, & Magnus, 2006). Specifically, people who suffer from anxiety disorders do not seek treatment for many reasons e.g. biased beliefs about therapists (Griffiths & Christensen, 2007; Taylor & Luce, 2003; Titov et al., 2008). Regarding specifically people with SAD, they do not seek treatment for reasons that also relate to characteristics of social anxiety, for instance avoidance and fear of negative evaluation (Cuijpers & Schuurmans, 2007). Therefore, this creates the need for novel treatments which can be widely acceptable by people who suffer from anxiety disorders and specifically SAD (Amir et al., 2009).

Attention bias modification treatment (ABMT) is one new promising treatment which seems to overcome many of the above-mentioned obstacles. Attention bias modification is a computerized intervention and therefore it eliminates the face to face treatment worries that individuals have. In addition, its access can be easier as it requires no or limited therapist involvement and it requires very short time for completion. Specifically, ABMT aims to reduce anxiety levels by changing attentional processes. It trains socially anxious individuals where to focus their attention, e.g. not focusing attention to an angry face. As of now there is some evidence, which supports the effectiveness of ABMT for SAD e.g. Amir et al., 2008; 2009; Lazarov et al., 2018; Li, Tan, Oian, & Liu, 2008; Naim, Kivity, Bar-Haim, & Huppert, 2018; Schmidt, Richey, Buckner, & Timpano, 2009, while other studies found no statistically significant differences from pre to post-treatment, suggesting no or little effectiveness e.g. Boettcher et al., 2013; Boettcher, Berger, & Renneberg, 2012; Bunnell, Beidel, & Mesa, 2013 Carlbring et al., 2012; Maoz et al., 2013; Neubauer et al., 2013. Therefore, results to-date seem to be mixed about the effectiveness of attention bias modification treatment for social anxiety. This is in contrast to several meta-analytic findings that tend to support the efficacy of this treatment for anxiety generally and rather than specifically for social anxiety e.g. Hakamata et al., 2010; Dennison, 2018; Linetzky, Pergamin-Hight, Pine, & Bar-Haim, 2015.

The theoretical rationale behind this treatment is that attention biases (AB) play a role in the etiology and maintenance of anxiety disorders (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn, 2007). The existence of attentional biases in

anxiety disorders is a robust result found with a variety of tasks (Cisler & Koster, 2010) and with various types of anxious populations. However, studies to-date do not fully agree with regards to the AB patterns that socially anxious individuals present. In general, it seems well documented that individuals with SAD present vigilance to threat, which means that they pay particular attention to social threatening information including signs of disapproval from others (Amir et al., 2009; Pishyar, Harris, & Menzies, 2004). In addition, some studies suggest that individuals with social anxiety actually have difficulties with disengagement of their attention from social threat (Amir, Elias, Klumpp, & Przeworski, 2003) and there is also some evidence that they present attentional avoidance, which means that they tend to avoid a threatening stimulus (Mogg, Bradley, Miles, & Dixon, 2004).

An effort to explain these different patters of AB can made by examining the factors that may contribute to these different effects. One of these factors is probably the levels of state anxiety that individuals with social anxiety experience (Bögels & Mansell, 2004; Shechner et al., 2012). State anxiety is the result of the presentation of a stimulus that produces anxiety (Pacheco-Unguetti, Acosta, Callejas, & Lupiáñez, 2010), during which individuals respond that specific moment with the feeling of tension, worry, activation of the autonomous nervous system, negative thinking and avoidant behaviors (Fountoulakis et al., 2006). Studies tend to support that higher state anxiety levels are connected to the presence of more attentional avoidance (Bögels & Mansell, 2004; Shechner et al., 2012).

This study aims to examine the effectiveness of ABMT for SAD in light of the mixed results in the existing literature. In addition, the study addressed the question that the mixed results on the effectiveness of ABMT for SAD to-date may be due to the limited attention that has been devoted to processes which may moderate its effectiveness. The present experiment attempts to clarify mechanisms of change in ABMT with socially anxious individuals by considering a number of the above moderators. First, taking into consideration the various types of attention bias it is important to consider the possibility that the effectiveness of ABMT for SAD may be moderated by whether socially anxious individuals demonstrate primarily vigilance or avoidance at baseline. In this case traditional ABMT may work only for the subset of participants who present attentional vigilance, which may explain why ABMT does not work for everyone (Boettcher et al., 2013; Mogg & Bradley, 2016). Secondly, the role of state anxiety needs to be taken into consideration as a moderator that could boost the effectiveness of ABMT for SAD. Investing into these research questions may be helpful for the design of more effective attention bias modification protocols. An additional limitation of previous work addressed

in the current study is to include an assessment of ABMT effectiveness at follow up. Except from Schmidt et al., (2009) who used follow-up measures 4 months later, no other studies assessed participants after a follow-up period to evaluate the maintenance of the effects of ABMT.

Current study

The present experiment aims to compare the effects of a traditional attention modification program with a placebo condition in reducing anxiety among socially anxious individuals. In this experiment, the intervention group was trained using the standard approach, which aims to eliminate attention allocation towards threatening faces and as a result to increase attention allocation towards neutral faces. It is the first study were treatment gains are evaluated at the end of treatment and 6 months later to examine the maintenance of treatment effectiveness. The experiment aims to contribute to the literature by replicating the few studies that applied successfully ABMT to SAD. Moreover, in order to reconcile previous mixed results, it aims to investigate the moderating role of pre-existing AB and state anxiety levels, a novelty of this investigation.

Research Hypotheses:

Based on previous findings of positive effects of ABMT on social anxiety, it was expected that the treatment group (attention modification program; AMP) in comparison to the placebo group (control condition; CC) at post-treatment and follow-up will present: 1) reduction in vigilance to threat as assessed by RT to the dot-probe task, 2) reduction in symptoms of social anxiety as measured by the structured interview and self-report measures. Furthermore, 3) reduction of vigilance to threat, as measured by the dot-probe task is expected to be the mediator of treatment effectiveness (reduced social anxiety symptoms), 4) pre-existing type of AB (vigilance or avoidance) will moderate treatment effectiveness, so that effectiveness is highest among those participants who present AB involving vigilance to threat and 5) state anxiety levels (assumed to be induced by the participation in the study; see procedure below) will moderate treatment effectiveness.

Method

Participants:

The sample was comprised of socially anxious undergraduate students. Participants, who scored above the clinical cut-off score -of 28 on the Difference subscale- of the Social Phobia and Anxiety Inventory–23, or scored 1 standard deviation above the

mean on the social anxiety subscale (M=21, SD=12; SPAI-23; Roberson-Nay, Strong, Nay, Beidel, & Turner, 2007) and agreed to participate in the study, were interviewed using the Anxiety Disorders Interview Schedule adult version (Brown, DiNardo, & Barlow, 1994) to confirm their SA status. A more liberal criterion than the clinical cut-off on the SPAI was deemed necessary for practical reasons in order to complete the required sample size of students with generally low levels of SA. However, only participants who met ADIS-IV criteria for social anxiety disorder were ultimately included.

The exclusion criteria of the study were the presence of current: 1) suicidal intent, 1) substance abuse, 3) primary diagnosis of post-traumatic stress disorder, obsessive-compulsive disorder, 4) or past schizophrenia, bipolar disorder, organic mental disorder, 5) any concurrent psychotherapy, 6) changes in medication during the 12 weeks prior to study and 7) CBT therapy during the 6 months before the beginning of treatment. These criteria were assessed via the ADIS – IV (Brown, Barlow, & DiNardo, 1994) except the last 3 issues, which were assessed through a short survey developed for this study.

In total 68 participants were selected from a screening sample for their high SPAI-23 scores and took part in the study. Eight of them had to be removed as they did not meet the ADIS criteria for social anxiety. Finally, the intervention group consisted of 32 participants and the placebo group of 28 participants (total 60 participants). Participants met the ADIS criteria for social anxiety (20 participants) or fulfilled the criteria of the specifier of social anxiety in DSM-5, i.e. performance anxiety[l] (40 participants).

Only 30 participants took part at the follow-up assessment which took place 6 months after study completion (16 at the intervention group, 14 at the placebo group). Reasons for not participation in the follow-up were typically a busy schedule (see Figure 1).

Procedure:

A briefing of the study was done in classes and students were informed about a package of questionnaires including the Social Phobia and Anxiety Inventory-23 *(*SPAI-23; Roberson-Nay, Strong, Nay, Beidel, & Turner, 2007) that they could fill out in order to receive extra credit in their classes. Additional students were recruited during mental health screening days which were organized by the University of Cyprus Mental Health Center. During the screening days students filled out the SPAI-23 and were informed about the services of the Center. Students who met the SPAI-23 above-mentioned criteria were invited to the study and those who consented were interviewed using the ADIS, in order to confirm the diagnosis of social anxiety. Interviewers were trained doctoral level clinical psychology students. At the end of the data collection, every interview was checked

between interviewers and the primary researcher in order to check the information with regards to the diagnosis criteria as well as to confirm against exclusion criteria. Informed consent was obtained for all stages of the study, which has received approval by the National Bioethics Committee. In addition, this study has been approved as a clinical trial by ClinicalTrials.gov.

Participants who met the inclusion criteria were randomly assigned to intervention group and placebo group and no information was given to them about their placement, except the instructions of the task which were the same for all participants. Prior research established that even if explicit protocol (providing information about the nature of the task e.g. specific training) had a result of better online learning, no differences were found in comparison with implicit protocol (providing no information about the nature of the task) with regards to offline learning and stress reactivity (Lazarov, Abend, Seidner, Pine & Bar-Haim, 2017). Researchers (post-graduate and under-graduate psychology RAs) who delivered the ABMT, were also blind to participants' group allocation. At the end of the experiment, participants were asked about their assumptions with regards to the training that they received, in order to assess their blindness to the study. All of them mentioned that they could not understand which group they were allocated to.

The first session included the following: participants were initially interviewed with the ADIS to verify their clinical status, and then they completed the attention bias assessment through a dot-probe task. Next, they completed a package of questionnaires assessing their anxiety levels (described below). Lastly, they received either the active intervention (training away from threat) or placebo training depending on their group assignment. The first session lasted approximately 1.5 hours.

During the next 7 training sessions (except the last one – 8th) participant received only the active intervention or placebo training depending on their group (both tasks last about 7 minutes for each session). These sessions occurred during a 3 week period, during which, participants received the intervention or the placebo training using the dot-probe task 6 times, twice a week. During these sessions, participants were given computerized task instructions. These guided them that on each trial a fixation cross would appear in the center of the screen, followed by a pair of faces and then by the symbol < or >. Participants were instructed to press the right or left mouse button based on which symbol was presented on the screen. They had to respond as quickly as possible trying not to make mistakes. All participants were instructed to use their dominant hand.

During the 8th and last session, participants received the last intervention or placebo training as usual. However, afterwards they also completed the self-report questionnaires again (post-intervention assessment) and their attentional biases were re-assessed using the dot-probe task. Lastly, participants were re-assessed with the ADIS. The last session also lasted approximately 1.5 hour.

The same exact procedure followed in the last session (only the assessment and not the training) was repeated 6 months later for the follow-up assessment.

Measures:

A battery of self-reported and clinician-rated measures of anxiety and dysfunction were used. All of them (except the study's inclusion/exclusion measure which was given only at pre-treatment level) were given at pre, post and follow-up times (Time1, Time2, Time3). The measures are as follows:

Study's inclusion/exclusion criteria questionnaire: This questionnaire asked questions related to study's exclusion criteria.

Anxiety Disorders Interview Schedule adult version (ADIS; Brown, Barlow, & DiNardo, 1994). This is a structured diagnostic interview assessing anxiety disorders, which permits differential diagnosis according to DSM–IV. It also assesses highly comorbid disorders with anxiety such as depression, somatoform disorders and substance abuse. A screening of psychotic symptoms as well as family psychiatric history can also be done. This interview showed excellent reliability for social anxiety (Di Nardo et al., 1993). The interview was given in order to confirm the diagnosis of social anxiety and to rule out other diagnoses according to the study's exclusion criteria.

Social Phobia and Anxiety Inventory-23 (SPAI-23; Roberson-Nay, Strong, Nay, Beidel, & Turner, 2007), is a shortened version of SPAI (Turner, Beidel, Dancu, & Stanley, 1989) and measures symptoms of social anxiety. SPAI-23 consists of two sub-scales: social phobia (16 items) and agoraphobia (7 items). Each item is measured on a 5-point scale from 0 (never) to 4 (always). The Agoraphobia sub-scale can be subtracted from the social phobia scale in order to give a Difference score. A Difference score of 28 or greater is indicative of social anxiety. The two scales presented good internal consistency and adequate test re-test reliability over 5 1/2 weeks (r=0.72) in a previous study (social phobia sub-scale, α=.95; agoraphobia sub-scale, α=.85; Roberson-Nay et al., 2007; Schry, Roberson-Nay & White, 2012), and good internal consistency in Greek-Cypriot adolescents (social phobia sub-scale, α=.92; agoraphobia sub-scale, α=.80;

Panayiotou, Michaelides, Theodorou, & Neophytou 2017). For the current experiment, internal consistency was very good to excellent (see table 2 for more information).

Psychiatric Diagnostic Screening Questionnaire (PDSQ; Zimmerman, & Mattia, 2001), aims to screen for the most common DSM-IV disorders. It is comprised of 125 yes or no questions. There is a clinical cut-off score of each disorder as well as some critical items, which need to be taken into consideration in order to derive a screening classification. In this study, only the category of social phobia was used. Generally, the PDSQ shows good to excellent internal consistency, test re-test reliability and validity (Zimmerman, & Mattia, 2001). Moreover, it showed very good internal consistency and the factor structure of it was replicated in a Greek-Cypriot student sample separate from the current one (unpublished data; PDSQ_SAscale Cronbach's alpha=0.85; Cronbach's alpha=0.87, Theodorou, Ioannou, Karekla & Panayiotou, 2013). For the current experiment, internal consistency was very good (see table 2 for more information).

Liebowitz Social Anxiety Scale Test (LSAS; Liebowitz, 1987). This is a 24 item self-report measure rated on a 4-point scale. It assesses fear and avoidance in social and performance situations during the past week. Scores of 55-65 indicate moderate social anxiety, 65-80 marked social phobia, 80-95 severe anxiety and score greater than 95 is indicative of marked social phobia. The index of this measure is an overall total score and additional six sub-scales: total fear, fear of social interactions, fear of performance situations, total avoidance, avoidance of social interaction, avoidance of performance situations. In the current study, only the total social anxiety score was used. The LSAS has overall good psychometric properties (test–retest reliability, internal consistency α=0.95, convergent and discriminant validity). In addition, it has been found to be sensitive to treatment change (Baker, Heinrichs, Kim, & Hofmann, 2002). Moreover, it showed very good interval consistency in Greek-Cypriot student sample separate from the current study collected by the researcher (unpublished data; Cronbach's alpha=0.94). For the current experiment, sample internal consistency was very good to excellent (see table 2 for more information). In addition, factor structure of the total score of the measure was supported in a Greek-Cypriot student sample separate from the current study (unpublished data).

State-Trait Anxiety Inventory (STAI; Spielberger, 1983). This is a brief form assessing trait as well as state anxiety in adults, comprised by these two scales. The state-anxiety scale consists of twenty statements, evaluating how the individual feels at the given moment. The trait-anxiety scale also consists of twenty items and evaluates how the respondent feels generally. Both scales are answered using a 1-4 scale, with high scores

indicating high anxiety. Scores can vary from 20 to 80 for both scales. In the current study, only the state anxiety sub-scale was used. Mean state anxiety levels under high stress condition (presence of a stressor) seems to be around M=47 and under low stimulus condition (absence of a stressor) around M=36 (e.g. Barnes, Harp & Jung, 2002). This measure shows good reliability and validity as well as excellent test re-test reliability in Greek adults, with similar scores as in the international literature (Fountoulakis et al., 2006). However, for the current study, internal consistency was not adequate (see table 2 for more information) Cronbach's). Therefore, results based on this instrument should be interpreted with caution.

The Dot probe attention task

In this study the Dot-probe task was adopted from the Tel Aviv University/ National Institute of Mental Health (TAU/NIMH) study. Specifically, this task includes face photographs of 20 different individuals (10 male, 10 female) taken from the NimStim stimulus set (Tottenham, et al., 2009), with the exception of one female picture taken from Matsumoto and Ekman set (Matsumoto & Ekman, 1989). Pairs of stimuli, angry - neutral faces or neutral – neutral faces of the same actor are presented vertically in the centre of the screen. In addition, two sets of pictures (A or B) are used, with the one to be used for assessment task and the other one for the training in a counterbalancing way.

All faces are presented on a background as in the Matsumoto and Ekman set and each picture is 45mm in width and 34mm in height. Each face is distanced from its pair 14mm. Both photographs are centered vertically, with equal distance to the top and bottom of the fixation cross. The top face is 20mm apart from the top edge of screen. Also, the screen background is black and photographs are surrounded by a single 58mm wide and by 94mm tall white rectangle, which shows the area of the screen that the participant needs to focus on.

Attention bias assessment

Attention bias assessment was done at pre, post-treatment and follow-up using the dot-probe task (see Figure 2), which consists of 120 trials (80 angry-neutral and 40 neutral-neutral presentations). Each trial begins with a fixation cross (500 ms; white cross 1*1 cm at the centre of the screen), on which the participants are instructed to focus their gaze. Then, a face pair display of 500ms duration follows. Next, a small visual probe (< or >) appears at the place of one of the two faces. Participants must determine which symbol appeared by clicking right or left on the mouse. Participants must click the correct button as quickly as possible. The target probe remains on the screen until there is a response, which starts a new trial. A new trial begins following an inter-trial interval (ITI) of 500ms.

There is a fully counterbalanced presentation of angry-face location, probe type and location as well as actor. Less than 70% accuracy determines experiment abortion. In this case, a warning gives the opportunity of the experiment to start from the beginning. No participant had to start over in the current study. Task completion takes about 5 minutes.

One way to assess AB using the dot probe task is the bias score (e.g., Bradley et al. 1998; MacLeod & Mathews 1988). The reaction time on stimuli which replace the threatening face when it is presented with non-threat (i.e., congruent trials) is subtracted from reaction time on stimuli which replace non-threat (neutral face) when it is presented with threat (angry face) (i.e., incongruent trials). A positive number reflects faster identification of threat. However, negative AB reflects quick detection of neutral stimuli and is interpreted as avoidance (Cisler, Bacon, & Williams, 2009; Bantin, Stevens, Gerlach & Hernmann, 2016). This is the most widely used formula for bias score calculation proposed by MacLeod, Mathews & Tata, (1986). [2]Difficulty of disengagement from threat is considered as the difference between the reaction time on stimuli which replace the neutral face when it is presented with a neutral face against the reaction time on stimuli which replace non-threat (neutral face) when it is presented with threat (angry face). Specifically, a slower reaction on neutral – threat trials in comparison to neutral – neutral trials represents difficulty of disengagement from threat (Amir, Taylor & Donohue, 2011).

ABM/placebo protocol

This protocol consists of 160 trials (120 angry-neutral and 40 neutral-neutral presentations). Again, each trial begins with a fixation cross (500 ms; white cross 1*1 cm at the centre of the screen), on which the participants are instructed to focus their gaze. For the current experiment the pair of faces which follows the fixation cross is presented for 500ms. Finally, the probe is presented with the same instruction as the assessment task.

In the placebo group, angry-face location, probe location and actor are fully counterbalanced with regards to their presentation and happen with equal probability. In the intervention group –training away from threat-, in all angry-neutral faces presentation the probe is presented only after neutral faces. Probe type (< or >) is not factorially counterbalanced but there is equal possibility of presentation for each of the following: angry-face location, probe location, or actor. Every 40 trials there is a short break. If accuracy is below 70%, a warning will be presented during the break, giving an opportunity for the experimenter to remind the participant not to compromise accuracy. The protocol needs about 7 minutes for completion.

Each participant was tested individually with 70cm distance apart from a 15'' computer screen. The program is on E-Prime 2 software (PST, Pittsburgh, PA).

Ethics

Participants provided informed consent in order to participate in the study. Additionally, participants were informed about the voluntary basis of their participation and their right to withdraw from the study at any point. Their personal data were kept anonymous and confidential. Participants were encouraged towards receiving treatment after the end of the follow-up assessment and were given information about specific referrals like the University of Cyprus Mental Health Center. However, they were encouraged to receive treatment before the end of the study if they personally wanted this or in case of serious dysfunctions related to their anxiety. In case that they were receiving therapy either at the post-treatment or the follow-up stage they were excluded from that specific assessment point.

Data analysis

T-test was used to verify participants' random assignment to group characteristics. Repeated measures ANOVA was used to test the effect of training (on attention bias - Threat bias- and anxiety symptoms). Threat bias: The reaction time to stimuli which replace the threatening face when it is presented with non-threat (i.e., congruent trials) was subtracted from reaction times on stimuli which replace non-threat (neutral face) when it is presented with threat (angry face) (i.e., incongruent trials). A positive number reflects faster identification of threat. However, negative AB reflects avoidance. The effect of training was examined with the pre and post measures, and separately pre- post to follow-up being the repeated factor and Group (intervention, placebo) the between factor. A separate analysis of pre to post and pre to post and follow-up was required due to the difference in sample size as only 30 participants participated at the follow-up level.

The moderating role of pre-existing ABs (PAB) and state anxiety was assessed separately using repeated Measures ANOVA (Between factors: Group and the moderating variable (PAB or state anxiety, Within variable: Time). [3] For the cutoff score of pre-existing AB positive numbers were considered as vigilance (n=33) and negative numbers were considered as avoidance (n=27). [4] With regards to the cutoff score of pre-existing state anxiety levels scores above the mean were considered as high state anxiety (n=26) and scores below the mean were considered as low state anxiety (n=27) (M=46, SD=4; Mean score was more related to high state anxiety levels based on the literature e.g. Barnes, Harp & Jung, 2002).

Conditions of univariate and multivariate normality, sphericity, homogeneity of variance / covariance, multicollinearity as well as linearity are fulfilled.

Finally, based on Alon et al., 2019 in order to achieve a power of 0.80 with α=0.05, two tailed and obtain the smallest effect found in previous studies (d=0.58, Schmidt et al., 2009) a sample size of 26 participants is indicated. Therefore, the current study represents an appropriate sample size to capture post-treatment effects.

Data Reduction

Dot – probe task

Reaction Time (RT) Trials were cleaned up before the analyses. Specifically, all the incorrect responses were removed as well as RTs shorter than 150ms or longer than 2000ms (about 1.5% in these data). Next, Z-scores were calculated per trial type (neutral-threat, neutral-neutral) and valence of face preceding the probe (threat, neutral). Trials greater than ǁ2.5ǁ *Z*-scores were removed. The number of trials (total) that usually needs to be removed are maximum 6%.

Self-reports and ADIS interview

No outliers were found in self-report measures (falling 2 standard deviations below and above the Mean).

Results

Group Equivalence

Preliminary analyses indicated no Group (intervention, placebo) differences at baseline on Threat bias t (58)=1.33, p=0.19, SPAI_diffscore t (57)=-1.75, p=0.09, PDSQ_SAscale t (57)=-0.25, p=0.80, Liebowitz_SA t (50)=-0.80, p=0.43, State_Anxiety t (51)=-0.32, p=0.75. 45 (see table 3 for Means and Standard Deviations).

data

Pre to post treatment effects

Repeated Measures ANOVA examined the intervention's effectiveness with Group as the between subject variable with two levels (intervention, placebo) and Time as the within subjects variable with two levels (pre-treatment, post-treatment). One more within variable was examined only for accuracy levels with 2 levels: Face valence (neutral, angry face).

Change in Attentional Bias (AB; Threat bias)

Results showed no effect of Time, F (1, 54) =0.01, p=0.93 and no main effect of Group, F (1, 54) =1.38, p=0.25 in attentional biases. In addition, no statistically significant interaction was found from pre to post treatment between Group and Time, F (1, 54) =1.10, p=0.30.

Change in Accuracy (ACC) levels

Results showed no effect of Time, F (1.33, 72.14) =1.50, p=0.23 and no main effect of Group, F (1, 54) =0.15, p=0.70, and no statistically significant interaction between Group and Time, F (1.33, 72.14) =0.30, p=0.65.

Changes in Social anxiety

Results also showed no changes in social anxiety from pre to post treatment in any of the self-reports measures: Specifically, there were no significant effects of Time, F (1, 53) =0.79, p=0.38, Group, F (1, 53) =1.71, p=0.20, or Group x Time interaction, F (1, 54) =1.10, p=0.30 on SPAI_diffscore. Similarly, there were no significant effects of Time, F (1, 53) =0.57, p=0.45, Group, F (1, 53) =0.05, p=0.83 or Group x Time interaction, F (1, 54) =0.31, p=0.58 on the PDSQ_SA scale, or Time F (1, 47)=2.05, p=0.16, Group, F (1, 47) =0.11, p=0.74, Group x Time, F (1, 47) =0.87, p=0.36 on the Liebowitz_SA scale.

Finally, with regards to the ADIS diagnoses from pre to post-treatment there was not an effect as all the participants maintained the same SA diagnoses from pre to post-treatment.

Moderators of treatment effects

Type of pre-existing AB (vigilance or avoidance) as moderator

Repeated Measures ANOVA examined the intervention's effectiveness with Group (intervention, placebo) and type of AB at pre-intervention (PAB: vigilance, avoidance) with two levels as between subject variables and Time as the within subject variable with two levels (pre-treatment and post-treatment).

Type of pre-existing AB did not enter any significant interactions with group and/or time, suggesting that it did was not a significant moderator of any effects (see table 4 for statistics).

State anxiety levels as moderator

Repeated Measures ANOVA examined the intervention's effectiveness with Group (intervention, placebo) and self reported state anxiety at pre-intervention (high state

anxiety, low state anxiety) with two levels as between subject variables and Time as the within subjects variable with two levels (pre-treatment and post-treatment).

State anxiety levels did not enter any significant interactions with group and/or time, suggesting that it did was not a significant moderator of any effects (see table 5 for statistics).

Experiment 1: pre to post-treatment and to follow-up assessment

Data Reduction

Dot – probe task

The same exact procedure was followed as section above. Outliers in the follow-up data were about 0.5%.

Self-reports and ADIS interview

No outliers were found in self-report measures (falling 2 standard deviations below and above Mean).

Group Equivalence

For participants who remained at follow-up preliminary analyses indicated no Group (intervention, placebo) differences at baseline on Threat bias t (26) =0.82, p=0.32, SPAI_diffscore t (26)=0.50, p=0.47, PDSQ_SAscale t (28)=0.18, p=0.73, Liebowitz_SA t (22)=0.85, p=0.84 (see table 6 for Means and Standard Deviations).

In addition, preliminary analyses indicated no differences at pre-intervention level between those who participated at the follow-up stage and between those who did not participate: on Threat bias t (57)=-1.47, p=0.15, SPAI_diffscore t (56)=-0.73, p=0.46, PDSQ_SAscale t (56)=1.08, p=0.28, Liebowitz_SA t (50)=1.15, p=0.26.

Results

Pre to post and to follow-up treatment effects

Repeated Measures ANOVA examined Group as the between subject variable with two levels (intervention, placebo) and Time as the within subject variable with three levels (pre-treatment, post-treatment and follow-up). One more within variable was examined only for accuracy levels with 2 levels: Face valence (neutral, angry face).

Change in Attentional Bias (AB; Threat bias)

Results showed no effect of Time, F (2, 52) =2.30, p=0.11 and no main effect of Group, F (1, 26) =1.97, p=0.17 in threat biases. In addition, no statistically significant interaction was found between Group and Time, F (2, 52) =0.95, p=0.39.

Change in Accuracy levels

Results also showed no effect of Time, F (1.38, 35.80) =1.07, p=0.38, Group, F (1, 26) =0.51, p=0.48, Group x Time, F (1.38, 35.80) =0.65, p=0.47 on accuracy.

Change in Social anxiety scores

SPAI_diffscore: Results showed an effect of Time, F (2, 48) =4.71, p<0.05, η^2=0.16 Pairwise comparisons showed that social anxiety at pre-level was significantly different from social anxiety levels at follow-up, p<0.05. However, SA levels were not significantly different from post-treatment to follow-up, p>0.05. Therefore, with regards to the main effect of Time a decrease of anxiety is presented from pre, M=34.03 (SD=8.34) to follow-up assessment, M=29.46, (SD=11.84). The decrease was not depended on the Group.

There was no main effect of Group, F (1, 24) =0.31, p=0.58 and no statistically significant interaction of Group x Time, F (2, 48) =0.03, p=0.97.

PDSQ_SAscale: Results showed no effect of Time, F (2, 52) =1.35, p=0.27 and no main effect of Group, F (1, 26) =0.44, p=0.51. In addition, no statistically significant Group x Time interaction was found F (2, 52) =0.04, p=0.96.

Liebowitz_SA: Results showed again no effect of Time, F (2, 42) =0.82, p=0.45, Group, F (1, 21) =0.03, p=0.86 and Group x Time, F (2, 42) =0.74, p=0.48. 53.

ADIS diagnoses

Finally, with regards to the ADIS diagnoses from pre to post-treatment and to follow-up there was not any difference as almost all the participants had the same diagnoses (only 2 participants did not meet the criteria for SA diagnoses at follow-up; 1 participant from the intervention and 1 participant from the placebo group).

Discussion

Currently studies show mixed results with regards to the effectiveness of Attention bias Modification treatment, an effect that needs further clarification. In addition, generally the maintenance of treatment effectiveness has not been studied in previous research. Moreover, it is essential to answer what moderates treatment effectiveness in order to

create more effective protocols. The different attention bias patterns that socially anxious individual present (Cisler & Koster, 2010) and the presence of state anxiety which is more connected to attentional avoidance (Bögels & Mansell, 2004; Shechner et al., 2012) may play some role in the effective modification of AB. Therefore, the current study aimed to examine ABMT effectiveness and its maintenance levels and to examine the moderating role of pre-existing AB as well as pre-existing state anxiety levels. ABMT was not effective in changing threat bias and as a result anxiety levels of socially anxious individuals from a college sample in the current study. No attentional biases changes were found from pre- to post-treatment level. In addition, there were no significant changes from pre- to post-treatment with regards to social anxiety diagnosis and self-report measures of anxiety. Type of pre-existing AB and state anxiety levels did not moderate treatment effectiveness at post-treatment. The same non-statistically significant results with regards to treatment effectiveness were obtained at the follow-up assessment point. However, there was some reduction of anxiety levels (effect of Time) from pre-treatment to follow-up in one of the self-reported measures (SPAI), which was not apparently related to the effectiveness of the training and may just reflect maturation, regression to the mean or other factors.

This study is not the only one finding no effect of ABMT, and negative findings like this may be important in delineating the circumstances under which the treatment is indeed effective. Our negative findings are in accordance with other studies that found no differences between the training and placebo group with regards to self-report, clinician interview and behavioral measures of social anxiety following the AB treatment (Bunnell, Beidel, & Mesa, 2013; Maoz et al., 213). Apart from the above - mentioned studies which used similar design as the current one (e.g. receiving training at the lab), additional studies found no treatment effectiveness as well. However, these studies investigated ABMT delivered through the internet, i.e. without researcher's contact (e.g. Boettcher et al., 2013; Boettcher, Berger, & Renneberg, 2012; Carlbring et al., 2012; Neubauer et al., 2013) and therefore may not be directly comparable to the current study.

In addition, a closer investigation of studies which support ABMT effectiveness may show some disadvantages in their design. Specifically, most of the studies show that treatment gains were found in clinician administered measures (Lazarov et al., 2018; Schmidt, Richey, Buckner, & Timpano, 2009) or state anxiety levels measured by behavioral assessment and self-report (Amir et al., 2008) and not on self-report measures of social anxiety at post-treatment. However, even if self-report measures of social anxiety

showed changes from pre to post-treatment, social anxiety levels were still above the clinical cut-off scores of social anxiety at post-treatment (Amir et al., 2009). Therefore, studies that showed effectiveness mostly found this result on clinician measures and measures of state anxiety. However, the only other study which investigated ABMT effectiveness in a follow-up assessment point found treatment gains that were maintained, and decrease of anxiety levels was shown on self-report measures (Schmidt, Richey, Buckner, & Timpano, 2009).

With regards to AB changes from pre- to post-treatment levels things are even more complicated taking into consideration the existing evidence, as some studies do not mention if ABMT effectively changed AB (Schmidt, Richey, Buckner, & Timpano, 2009); other studies found no changes (Lazarov et al., 2018) while others found some evidence of reduction of AB (Amir et al., 2008; 2009). Bunnell, Beidel, & Mesa, (2013) and Maoz et al., (2013) who found no effectiveness of ABMT, did not assess AB levels or had low baseline attentional biases of the sample respectively. However, from the existing evidence, it seems that participants with limited attentional biases toward threat do not present with gains in comparison to control groups (Amir, Taylor, & Donohue, 2011). Therefore, a question that arises in relation to the present null findings is whether participants did not have significant initial threat bias and if type of pre-existing bias would have moderated effects.

To address this issue, level of initial bias was specifically examined. It appears that in the current sample most of the participants, n=33, presented limited AB (their AB levels were close to zero (M=1.73, SD=7.30). It seems that 15 of them presented Avoidance (M=-26.21, SD=15.82) and 18 of them presented Vigilance (M=28.54, SD=14.55). Based on the above, one of the reasons of no statistically significant results of this study maybe is that almost half of the participants presented with no AB in comparison to the neutral stimuli and a significant proportion presented avoidance instead of vigilance. The presence of the latter group creates the question of how useful it is to train individuals to avoid a threatening sing when they already avoid it. ABMT may only work for the subset of participants who present vigilance or difficulty of disengagement from threat. Moreover, with regards to treatment moderators maybe the current sample of participants who presented attentional vigilance was not large enough or severe enough to capture the treatment effectiveness.

In addition, state anxiety levels did not play a role in the training efficacy. This maybe due to the fact that participants were not under a stressor when answering the

questionnaire, limiting state anxiety levels. On the other hand, participants presented high mean state anxiety levels based on the literature (e.g. Barnes, Harp & Jung, 2002), showing that probably some of them experienced state anxiety. Again, the reason of not capturing statistically significant effects may is related with the small sample size for this specific question.

Last but not least, another explanation of the absence of effectiveness of ABMT to change attention bias and anxiety levels could be related to the fact that participants were not treatment seekers (mostly participants did the study for extra credit for their classes) but the study was advertised as a study which assessed 'if attention processes change can result in changes in social anxiety levels'. This is in contrast with some other studies e.g. (Amir et al., 2009; Schmidt et al., 2009) which found effectiveness. Not seeking treatment limits placebo effects, which is both a positive aspect of this study and a limitation in restricting effects of demand and expectations. However, the Bunnell et al., (2013), study which was comprised of treatment seekers also found no effectiveness of ABMT. The reason for using this type of advertisement has to do with the sample, which was comprised by University students and not community treatment seekers.

Given the null findings of the present study, but the supportive evidence in favour of ABMT in some previous studies for SA, and a bulk of studies for trait anxiety, more studies are needed in order to address the specific circumstances of ABMT effectiveness and variables which may moderates its effectiveness. For example, future research needs to investigate the match of pre-existing AB type with the training, for example some participants may need to receive training towards threat, in order to see the effect of training on attentional avoidance reduction. In addition, more studies are needed to examine treatment maintenance gains in the long run as no previous studies examined long term effectiveness (except one study), and the current study did not present any supportive evidence.

Limitations

The results of this experiment should be seen in light of some limitations. First the study's sample was comprised of individuals with probably subclinical levels of social anxiety, as students are usually considered as a more functional population than treatment seeking samples. However, it should be stressed that all participants met ADIS criteria for SA. Also, although the sample was relatively small, according to power analysis, there was adequate power in order to find statistically significant effects from pre- to post-treatment

effectiveness. With regards to treatment moderatos a larger sample was going to offer a better examination of this specific question and therefore results of it should be interpreted as preliminary. Another limitation may have to do with composition of the sample which was comprised of participants with general social fears and performance anxiety fears. The mixed nature of the group may be considered to have affected the possibility to find an effect of ABMT training. Even though based on previous research, individuals with performance anxiety (a subtype of social anxiety) have a similar sociodemographic profile with socially anxious individuals, general social anxiety is more severe than performance anxiety (Kessler, Stein, & Berglund, 2014). It should be noted that an exploratory examination of ABMT effectiveness separately for the 2 groups in the current study showed no difference between them.

Another limitation of the study pertains to the attrition rate from post-treatment to follow-up which may have affected the power of analyses in order to find statistically significant results at this last assessment point. However, given the absence of significant effects at post treatment, it is unlikely that effects would have appeared six months later. Another limitation is the fact that, no inter-rater reliability assessment of the diagnosed based on ADIS interviews was conducted. However, a check of the diagnostic assessment was done also results from self-reports and AB measures suggest that there was no change in diagnostic status from pre- to post-and to follow-up assessment, which provides validation for the initial diagnoses. In addition, the measure of state anxiety presented inadequate internal consistency which may have affected its non-significant role in treatment effectiveness. One possible explanation of no good internal consistency of this questionnaire may has to do that it has been standardized in Greek speaking sample in Greece and not a Greek speaking sample in Cyprus. Nevertheless, most importantly receiving of training did not present any statistically significant results either.

Furthermore, the first and last training were done the same day as the assessment which may had the effect to undo the training. Nonetheless, participants received 8 sessions in total which means there were 6 sessions without this limitation, which is an adequate number of training sessions, based on previous evidence, in order to be able to get an effect. On a more general issue, this study investigates AB using dot-probe task which is the most well-known task; nonetheless recent studies seems to question its reliability (e.g. Price et al., 2014; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). A more reliable task for example eye-tracking could give better results with results to AB assessment.

Conclusion

This study found no effectiveness of ABMT in self-report and clinician administered measures. Most importantly, no reduction of AB has been found from pre- to post-treatment. The investigation of the type of pre-existing AB levels as well as state anxiety levels revealed no moderation of treatment effectiveness by these variables. The current study, the second to investigate ABMT efficacy at 6 months follow-up also found no long- term effects of attention training.

An examination of the type of pre-existing AB levels in the current sample showed AB in the form of either vigilance or avoidance. Training away from threat aims to reduce vigilance; therefore, the existence of different AB types creates the need of an examination of other ways of training, e.g. training towards a threatening face in order to investigate the effectiveness of avoidance reduction. Therefore, more studies are needed to investigate the current mixed results about ABMT effectiveness and pay particular attention to treatment moderators e.g. pre-existing kind of AB or state anxiety levels (including the presence of a stressor).

Footnotes

[1] No differences were found in treatment effectiveness in any measure between general social anxiety and the specifier of performance anxiety.

[2] Difficulty of Disengagement was also checked for possible changes from pre- to post-treatment and separately from pre- to post- and follow-up assessment. Results were also non-statistically significant.

[3] These 2 groups presented a pattern of difference (even though it was not statistically significant) in the 3 questionnaires measuring social anxiety at pre-treatment. Those who presented vigilance towards threat scored higher than avoiders in these 3 measures. However, the moderator of PAB was scored and analyzed with one more way: cutoff score of pre-existing AB was ½ standard deviation below (avoidance) and above (vigilance) of the mean of threat bias (+- 14 from 0). Results were again non-statistically significant.

[4] The moderator of state anxiety was scored and analyzed with three more ways: 1) 1 standard deviation above the mean considered as high state anxiety and the remaining participants were considered as low state anxiety (M=46, SD=4), 2) 1 standard deviation above the mean considered as high state anxiety and 1SD below the mean considered as low state anxiety (M=46, SD=4). All results were non-statistically significant.

CHAPTER 3

Experiment 2: What if training away from threat reduces negative affect under stressor? The role of attentional avoidance.

Abstract: This study aims to examine Attention Bias Modification Treatment (ABMT) and possible predictors of treatment effectiveness. Specifically, this experiment compares training away from threat, placebo group and a third group of training towards threat (i.e. exposure), investigating if extinguishing attentional avoidance can also affect anxiety levels. In addition, moderators of treatment effectiveness were investigated, specifically pre-intervention attentional biases (AB) and state anxiety levels. Participants were 82 adults with social phobia who were randomly allocated into 2 training and placebo groups. Participants were assessed with regards to AB changes. Social anxiety changes were assessed with self-report measures, behaviourally (speech stressor) as well as physiologically to better demonstrate that anxiety reactions to anxiogenic situations have been reduced from pre to post treatment. Results showed non-treatment effectiveness in all measures and all groups except the corrugator supercilii (frown) measure. This measure was decreased during a speech assessment only in training away from threat group. Corrugator supercilii reduction at this specific training was presented only for attentional avoiders. State anxiety levels did not moderate treatment effectiveness. The reduction of negative affect (as indexed by the corrugator) can be considered as a useful result for socially anxious individuals in order for them to tolerate a stressful situation. Future research may need to investigate more this result and the possible mechanism of its effectiveness. In addition, ABMT effectiveness and under which circumstances has positive results needs to be more investigated.

Introduction

Social anxiety is a disorder with high prevalence rates (Barlow & Durand, 2000) and is related to low quality of life (Stein & Kean, 2000) as well as to additional risk for the development of more psychopathology (Schneier et al., 1992). Studies highlight that the existence of attention biases (AB) play a major role in the etiology and maintenance of anxiety disorders (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn, 2007). A recent meta-analysis of 172 studies with different populations, tasks and stimuli found that attention bias is a robust phenomenon (low to medium effect size of d=.45; Bar-

Haim et al., 2007). Therefore, the existence of attentional biases is a robust result, found with a variety of tasks and across anxiety disorders (Cisler & Koster, 2010).

In general, it seems well documented that individuals with SAD pay particular attention to social threatening information (attentional vigilance), including signs of disapproval from others (e.g. a threatening face) (Amir et al., 2009; Pishyar, Harris, & Menzies, 2004). In addition, there is some evidence that individuals with social anxiety have difficulties with disengagement of their attention from social threat (Amir, Elias, Klumpp, & Przeworski, 2003) and that they present attentional avoidance (Mogg, Bradley, Miles, & Dixon, 2004). Therefore, although there is agreement that AB is characteristic of social anxiety, there is little agreement as to what type of AB socially anxious individuals show.

Attention bias modification is a computerized intervention that was developed based on the premise that anxious individuals show bias towards threat, which gained ground in the research literature. An attention bias modification protocol aims at reducing vigilance towards threat, so as to reduce anxiety through changing this automatic focus of attention. The most commonly used task to modify attention biases is the dot-probe task. When this task is used to modify AB, a symbol is presented after a pair of faces (angry and neutral face) and participants are asked to provide an answer regarding where the symbol was presented; i.e. after the neutral or angry face. In attention bias modification the presentation of response targets is only after neutral and not after threat stimuli. Therefore, participants are trained not to allocate their attention to threat e.g. an angry face but instead to neutral stimuli. This leads to implicit learning through repetition of trials (Bar-Haim, 2010) that is believed to be probably maintained after the task and generalize outside the lab context.

Traditionally, cognitive-behavioral therapy is considered as the most effective treatment of social anxiety and one of its essential mechanisms is the reduction of avoidance of situations considered as threatening (Albano & DiBartolo, 2007). However, many individuals are reluctant to receive traditional exposure therapy, due to their tendency to avoid their feared situations (Garcia-Palacios, Botella, Hoffman, & Fabregat, 2007) and the social interactions that are necessary for exposure therapy in this case. In such cases ABMT could act as a significant substitute to traditional CBT, along with other recent alternatives to traditional in vivo exposure therapy, including Virtual reality exposure therapy (VRET) (Powers & Emmelkamp, 2008); both these treatments require little therapist contact and/or allow for easy exposure to a variety of social situations.

First, however, the effectiveness of ABMT for social anxiety needs to be further established along with a clarification of its mechanism of action. To-date there are some studies which support the effectiveness of ABMT in social anxiety e.g. Amir et al., 2008; 2009; Lazarov et al., 2018; Li, Tan, Oian, & Liu, 2008; Naim, Kivity, Bar-Haim, & Huppert, 2018; Schmidt, Richey, Buckner, & Timpano, 2009. Other studies found no statistically significant difference from pre to post-treatment in attention biases, arguing against the effectiveness of this treatment for socially anxious individuals e.g. Boettcher et al., 2013; Boettcher, Berger, & Renneberg, 2012; Bunnell, Beidel, & Mesa, 2013 Carlbring et al., 2012; Maoz et al., 2013; Neubauer et al., 2013 (see also results of chapter 2). Therefore, results to-date seem to be mixed about the effectiveness of attention bias modification treatment in social anxiety, although meta-analytic findings tend to support its efficacy for anxiety generally e.g. Hakamata et al., 2010; Dennison, 2018; Linetzky, Pergamin-Hight, Pine, & Bar-Haim, 2015.

The mixed results on the effectiveness of ABMT for SAD may be due to the limited attention that has been devoted to two crucial questions. These questions refer to the mechanism of change in ABMT as well as to the processes which moderate effectiveness. With regards to the mechanism of change as it has been mentioned above ABMT claims to change either vigilance to threat or difficulty disengagement from it, even though some additional potential mechanisms were investigated in a few studies, including attentional control changes (Klumpp & Amir, 2010), or reduction of attentional avoidance (Boettcher et al., 2013). One could suggest that the aim of ABMT to train attention focus away from threat may reinforce avoidance in those individuals who already demonstrating this pattern of biases away from threat, and it may come into conflict with the aims of traditional exposure psychotherapy theories. Traditional exposure psychotherapy theories suggest that engaging in safety behaviors, like avoidance will prolong anxiety due to lack of habituation or change in learning (Albano & DiBartolo, 2007; Muhlberger, Wieser, & Pauli, 2008).

In the Boettcher et al., (2013) study participants received internet-based training which included training towards positive faces as well as placebo training. However, a third group of participants was added, which received training *towards* threat faces, with the aim to reduce avoidance. Training towards threatening stimuli aims to decrease avoidance of threat instead of the typical condition which involves training towards the neutral stimuli in order to improve vigilance or disengagement from threat. Results showed that social anxiety levels reduced from pre- to 4 months follow-up assessment in all 3

conditions with the condition of training towards threat producing significantly higher reduction of social anxiety than the placebo condition. If ABMT (of some type) is found to work, both for individuals who show hypervigilance when receiving training away from threat, and for those individuals who show avoidance by reducing attentional bias away from threat (by training towards threat), its benefits may be applicable to a wider spectrum of anxiety presentations and it may evolve into a viable alternative to traditional CBT for SAD.

With regards to the processes which moderate treatment effectiveness, the role of state anxiety needs to be taken into consideration as a moderator that could boost the effectiveness of ABMT for SAD. A review of this literature suggests that most of the studies which concluded that people with SAD show attentional avoidance appear to have some specific methodological characteristics compared to those that did not find avoidance effects, such as the presence of a state anxiety manipulation, for example a public speaking stressor (Bögels & Mansell, 2004; Shechner et al., 2012). It seems that under a stressor, individuals respond with the feeling of tension, worry and probably the activation of the autonomous nervous system as well as with negative thinking and avoidant behaviors (Fountoulakis et al., 2006). Even though in chapter 2 state anxiety was not found to be a significant moderator, it should be noted that in that case state anxiety was measured but was not specifically manipulated, something that the current study tries to remedy.

Current study

This study aims to compare the typical ABMT training away from threat with training *towards* threat and a placebo condition in order to examine the role of attentional avoidance and the need to match treatment to type of AB, as described above. In addition, this study examines state anxiety as a potential moderator that can lead to a more effective intervention. Specifically, state anxiety was measured before the ABMT intervention with a self-report measure during anticipation of a brief public speaking task. As noted above, studies which showed that individuals with social anxiety present attentional avoidance had included a condition which created state anxiety e.g. giving a speech. The assessment of AB in this experiment was done under state anxiety in order to increase the possibilities that participants will present attentional avoidance. Therefore, we considered it important for the participants to receive the attention training under a state anxiety manipulation (i.e. informing them that may need to give a speech after the training) in order to elicit attentional avoidance and examine if this process is going to be modified by the training.

Another factor that needs to be considered regarding the effectiveness of ABMT in social anxiety has to do with the way this is measured, a topic deserving further examination. With the exception for some investigations involving behavioral measurements (e.g., Amir et al., 2008), and physiological measures (Heeren, Reese, McNally & Philippot, 2012) research has focused on self-reports and diagnostic evaluations *(*MacLeod & Mathews, 2012). It appears that significant effects of ABMT have been found in clinician ratings, but not consistently in self-reported symptoms of social anxiety. Also, ABMT in most of the cases was not found effective on internet-based interventions where clinician ratings could not be obtained. According to Bradley & Lang, (2000), emotions are expressed through three different systems: a) language (self-report), b) overt behavior (e.g. avoidance of eye contact or talking very softly during a speech) and c) physiological responses (e.g. heart rate). Therefore, more studies using physiological and behavioral measurements of treatment change are needed in order to present converging evidence on the effectiveness of ABMT.

In terms of measurement in experiment 2, anxiety was measured, in addition to self-report, with behavioral (participants' self-assessment of their speech and their anxiety during the speech) and physiological indices in order to verify changes in anxiety responses due to ABMT. Changes in heart rate (HR) and skin conductance response (SCR) (among other physiological measures) are indicators of autonomic activation by negative emotional stimuli (Egloff, Schmukle, Burns, & Schwerdtfeger, 2006; Staugaard., 2010), and corrugator supercilii (frown) is a behavioural indication of negative affect describing a defensive reaction to a phobic or unpleasant stimulus (Vrana & Gross, 2004). As with other anxiety disorders, socially anxious individuals tend to present with exaggerated heart rate during social performance activities (Hofmann, Newman, Ehlers, & Roth, 1995; Kotlyar et al., 2008; Levin et al., 1993; Panayiotou & Vrana, 1998) as well as with exaggerated skin conductance (Eckman & Shean, 1997). The only studies in the domain of ABMT, which used physiological measures (Heeren et al., 2012; Lazarov et al., 2017), assessed only skin conductance reactivity (SCR), which is a good measure of sympathetic arousal but not of parasympathetic control (i.e. the ability to regulate emotional reactions) and does not capture the valence of the affective response. The addition of a specific negative valence measure, corrugator response, and another autonomic measure sensitive to both sympathetic and parasympathetic influences (heart rate) will remedy this limitation and provide a wide range of data regarding the affective responses of socially anxious individuals and the specific changes that come about in relation to ABMT.

Taking all the points into consideration, the second experiment aims to expand on the basic ABMT paradigm in order to address a) the role of potential outcome moderators, specifically pre-existing attention biases and state anxiety, and b) ways of measuring effects of ABMT. Finding predictors of maximal response to treatment is essential to inform important modifications to treatment procedures and can also lead to making available specific treatments for specific patients with the aim to achieve optimal results (Steketee & Chambless, 1992) and bridge the gap between research and practice (Kazdin, 2008). Investing into these research questions may be helpful for the creation of more effective attention bias modification protocols. The current study aims to address these issues in its primary aims.

Research Hypotheses:

For experiment 2: The 2 treatment groups (training towards and training away from threat) in comparison to the placebo group at post-treatment will show 1) reduction of attentional vigilance or avoidance depending on the group training, 2) reduced social anxiety on self-report measures, 3) reduced social anxiety at the behavioral level during the speech task measured by the participant's self-assessment of experienced distress and performance during the speech, 4) reduced physiological reactions: heart rate and skin conductance (showing lower arousal) and corrugator supercilia (showing reduced negative valence) during the speech, 5) reduction of either type of AB will mediate treatment effectiveness, 6) pre-existing kind of AB will moderate treatment effectiveness and 7) pre-existing state anxiety levels will moderate treatment effectiveness.

Method

Participants:

Inclusion and exclusion criteria of this experiment are exactly the same as for experiment 1 (see participants section above).

In total 90 participants took part in the study. Eight of them had to be removed as they started taking CBT for social anxiety during the study. Participants were randomly allocated to the 2 training groups or placebo condition. In the end, the training away from threat group consisted of 29 participants, the training towards threat by 29 participants and the placebo group of 24 participants (total 82 participants; see Figure 3). All of them met the ADIS criteria for social anxiety disorder (40 participants) or fulfilled the criteria of the specifier of social anxiety in DSM-5, i.e. performance anxiety (42 participants) [1].

Procedure:

Recruitment of participants was done as for experiment 1 (see procedure section above). This study has been also approved as a clinical trial by ClinicalTrials.gov.

For this experiment, a random number of interviews (1/3) were recorded and assessed by independent interviewers for reliability. Some minor differences in the scores of the two reviewers were found in 5 interviews with regards to a) whether the diagnosis was social anxiety disorder vs the performance anxiety specifier b) with regards to whether SAD was a secondary diagnosis. Disagreements were resolved through consensus.

Session 1:

Before the first session participants were interviewed using the ADIS. At the first session, firstly they were informed that at a later point they were going to give a short speech during which they would be video-recorded, in order to get a measure of their behavior during the speech. After being informed about the speech, assessment of attentional biases was done using both the eye-tracking and the Posner task, with completion of self-report questionnaires following. These included a measure of state anxiety, in between the two tasks. The last part of the first session included the speech task during which physiological reactions and self-reported distress were collected. Specifically, participants were asked to move to a different room and were instructed to sit in a comfortable chair, where they were informed about the subject of their speech and were given a few minutes to prepare their talk. Next electrodes were attached (for details see the section below). Then, participants were asked to relax for 5 minutes, in order to record their baseline psychophysiology measures. This was followed by the speech task, during which participants had to present their prepared speech for 2 minutes. Participants' speeches were video-recorder. Two different speech topics (a negative experience with a friend or a negative academic experience) were counterbalanced as to whether they were presented at the beginning or at the end of the intervention, based on Heeren et al., (2012). The experimenter asked participants to rate their levels of anxiety from 0 (not anxious) to 10 (extremely anxious) before the speech and after the speech and to report their maximum levels of anxiety (Subjective Units of Discomfort Scale [SUDS] during the speech; Wolpe, (1958). SUDS in combination with the state anxiety questionnaire were also used as a manipulation checks in order to confirm that the speech task had the intended effect of creating high anxiety levels in participants[2]. Psychophysiological measures were taken for the 2 minutes during the speech and for 5 minutes after the speech in order to assess recovery. Data collection was controlled by the AcqKnowledge program for physiological

measures. Lastly, participants assessed their experienced performance during the speech. The first session lasted for approximately 1 hour and 15 minutes.

Sessions 2-4:

Another 4 appointments were scheduled after session 1. Session 2, 3, 4 and 5 included training either towards neutral or toward angry faces or the placebo intervention using the dot-probe task, depending on group assignment. Each session lasted about 7 minutes. At the beginning of every session participants were informed that a random number of participants will have to repeat their speech. They were informed that relevant instructions would be given right after the dot probe task completion. This manipulation was given in order for the participants to maintain their state anxiety levels, but repetition of the speech task did not actually happen at this stage.

Session 5:

Finally, the last session was identical to session 1 with some minor modifications. Specifically, initially participants were informed that they are going to perform the speech task during the session. Next, they had to do the final eye-tracking, self-report questionnaires and Posner task (in this order) in order to assess any changes in attentional biases and anxiety. Last, they were asked to do the speech task but on a different topic (the alternate of what they were given at session 1, following the same procedure and using the same physiological measures as in session 1 in order to assess any improvement in anxiety and performance. The last session lasted approximately 1 hour and 15 minutes.

Measures

Questionnaires

A battery of self-reported and clinician-rated measures of anxiety and dysfunction were used. All of them were given at pre and post treatment, except the demographics questionnaire and the ADIS interview which were given only at pre-treatment to establish diagnosis. The description of the measures is the same as for experiment 1, except for the demographics questionnaire and the Public-speaking performance measure which were given only in the current experiment.

Demographics questionnaire: This questionnaire asked for basic demographic characteristics and questions related to the study's exclusion criteria.

Public-speaking performance measure (PSP; Rapee & Lim, 1992), this measure is completed by independent observers and the participants. It assesses 12 specific aspects of performance, such as eye contact with audience, clear voice and 5 general aspects of performance for example keeping the audience interested, generally spoke well etc. A 5-

point scale is used for each item from 0 = not at all and 4 = very much. Higher scores indicate better speech performance. This measure shows good internal consistency (r = .84; Rapee & Lim, 1992). In this study only the self-assessment scale was used. The internal consistency of the scale for this study was not adequate especially at post-treatment (see table 7 for more information). Therefore, results based on this instrument should be interpreted with caution.

A description of the remaining questionnaires: *Social Phobia and Anxiety Inventory-23, Psychiatric Diagnostic Screening Questionnaire, Liebowitz Social Anxiety Scale Test, State-Trait Anxiety Inventory* can be found in Chapter 2. Information about their internal consistency for the current sample can be found at table 7. Not adequate internal consistency was found for the PDSQ at post-treatment and the state anxiety measure across measurements. Therefore, results based on these instrument should be interpreted with caution.

Eye-tracking

Assessment of eye-movements and visual scanning with eye-tracking of the visual display, to assess biased attention to or away from threatening faces, was done pre and post treatment. Eye- tracking was also used to assess changes in attention biases following treatment during the last session of this experiment. Eye movements (EM) were recorded using the EyeLink 1000 Plus Desktop Mount. The system consists of a high-speed camera constructed for eye tracking, a head stabilizer, a Display PC which displays the stimuli (images) and a Host PC which process the camera data.

The stimuli used in this study were the same as in Lazarov, Abend, & Bar-Haim (2016). Specifically, 16 male and female color photographs were taken from the Karolinska Directed Emotional Faces database (KDEF; Lundqvist et al., 1998). These photographs represented disgust and neutral emotional expressions. The rationale for using disgust faces as social threat is explained by Staugaard (2010) and Waechter et al., (2014). Based on Lazarov, Abend, & Bar-Haim (2016) faces were selected that ranked highest on ratings of disgust emotional expression but which did not expose teeth. These 16 photographs included 8 male and 8 female photographs matched on ratings. Each photograph was 900 x 900 pixels in a matrix included 2 sets of 4 male x 4 female faces (total 16 faces). Each face was 225 x 225 pixels and included a 10-pixel white margin on every edge. Each face appeared randomly on the matrix under the following conditions: a) each actor appears once in each matrix, b) each matrix contains 8 female and 8 male faces, c) half of the faces had a disgusted and half a neutral face expression, d) two of the four inner faces are always disgusted and the other two are always neutral faces (see Figure 4).

For the eye tracking assessment, participants were seated 50cm from the computer screen. They were asked to place their head in the chin rest at which time the calibration procedure followed, which records the position of the eye at 9 target locations (in the four corners of the screen, midway in between these locations as well as in the screen center) in order to confirm that the required data are recorded. After that, the task began. Each trial began with a fixation cross for 1000ms only when participants fixated at the center of the screen. Then the presentation of the matrix followed for 6000ms. The inter-trial interval until the next fixation cross was 2000ms. Participants were instructed to direct their gaze to the fixation cross and then look at the pictures in any way they choose. Each participant observed 2 blocks comprised of 30 matrices per block (total 60 matrices). Each facial expression was presented 15 times in each block. Blocks were separated by a one-minute break.

The recording of eye movement data was done continuously, however data from the beginning of each trial to the picture offset were analyzed. Fixations were defined as at least 100ms of stable eye location within 1-degree visual angle. For each matrix two areas of interest (AOIs) were defined, one including the 8 faces with the disgust expression (the threat AOI) and one including the 8 faces with the neutral expression (the neutral AOI). With regards to the outcome measures the indices which were derived are: a) *total dwell time*: average total dwell time for each AOI across the 60 matrices for the whole time of 6000ms as well as for the time phases of 0-500ms, 500-1000ms and 1000-1500 [3].

Posner task

Faces used in this study were also selected from the KDEF (Lundqvist et al., 1998). Sixteen neutral and sixteen threatening faces were used. The selection of faces was done in a separate study in which they were normed in a Cypriot sample (Theodorou, 2017). Participants had a total of 256 experimental trials separated in 2 blocks (128 trials in each block). Two thirds (2/3) of the trials were validly cued (128 = 16 faces x 2 faces type x 2 face position x 2 repetitions), 1/6 were invalidly cued (64 = 16 faces x 2 face type x 2 face position), and 1/6 were uncued (64 = 16 faces x 2 face type x 2 face position). Trials were presented in a different random order for each participant. The decision regarding the proportion of faces used in this study was based on Amir et al., 2003.

The computer displayed brief experimental instructions. Participants were instructed to fixate on a cross at the center of the screen located between two rectangles. A cue (neutral or threatening face) directed participants' attention in one of two rectangles. The face remained on the screen for 600ms. After than an asterisk was presented in one of

two locations (rectangles) and participants were instructed to press the right button of the mouse if the asterisk was presented on the right and press the left button of the mouse if the asterisk was presented on the left. The next trial started right after participants gave their answer or after 3 seconds of no answer. The inter-trial interval lasted for 1650ms. On some trials the asterisk was presented at the same position of the cue (valid cue), while on other trials the asterisk was presented at the opposite direction of the cue (invalid cue). In addition, as mentioned above in some trials no face (cue) preceded the asterisk (uncued).

It is assumed that if participants present with vigilance to threat, they will have faster response latencies when they detect validly cued targets with regards to threatening faces in comparison to neutral faces. However, if they have longer response latencies when they detect invalidly cued targets following threatening faces in comparison to neutral faces, then they are assumed to present difficulty of disengagement from threat.

Physiological measures

Psychophysiological data were recorded with BIOPAC MP150 (BIOPAC Systems, Inc., Goleta, CA). Signals sampling was done at 1000 Hz. Data were analysed offline using of AcqKnowledge 3.9.0 (BIOPAC Systems, Inc.).

Skin conductance (SC)

Skin conductance levels (SCL) were recorded continuously using a BIOPAC GSR100C transducer amplifier. Skin conductance reactivity (SCR) was measured by a pair of electrodes attached in the thenar and hypothenar eminences of palm after it was cleaned with tap water. Skin conductance paste was used as an electrolyte.

Heart rate (HR)

The signal was amplified using a BIOPAC ECG100C bioamplifier, recording raw EKG, which was converted on line to HR between 40 and 140 beats per minute. Electrodes were filled with gel and placed on each inner cleaned forearm.

Corrugator supercilii

Electrode placements recommended by Fridlund and Cacioppo (1986), were used in order to record corrugator facial muscle regions from the right side of the face. The skin was cleaned and then electrodes were filled with gel and applied. The signal was amplified using BIOPAC band-pass filters (20-500 Hz, as recommended by Van Boxtel, 2010), rectified and integrated over 20 samples.

SC, HR and Corrugator responses were recorded for 5 minutes before and after the speech and during the 2 minutes of the speech. The 3 measures were compared from pre to post task only during the speech. A significant decrease in the difference in score between

pre-test and post-test autonomic measures and the measure of negative valence was expected to indicate a decrease of anxiety at post-treatment (e.g., Kozak, Foa, & Steketee, 1988). Scores of pre-speech and post-speech from pre- and post-treatment were not analyzed for the current study due to sample size restrictions and because the examination of physiological scores during the speech was more relevant to the research hypotheses.

The Dot probe attention task

The dot-probe task was used only for the training of the participants which was done during sessions 2-5.

ABM/placebo protocol

The protocol description is the same as for the previous experiment. The only difference for the current experiment is the second ABMT condition –training towards threat. In this case in all angry-neutral face presentations the probe is presented only after a threat face.

Ethics

Participants provided informed consent in order to participate in the study. They were informed about the voluntary basis of their participation and their right to withdraw from the study at any point. Their personal data were kept anonymous and confidential. Participants were encouraged for receiving treatment after the end of the post-treatment assessment and were given information about specific referrals like the University of Cyprus Mental Health Center. However, they were encouraged to receive treatment before the end of the study if they personally wanted this or in case of serious dysfunctions related to their anxiety. In case that they were receiving therapy before the end of the study they were excluded from post-treatment assessment.

Data analysis

To test group differences with regards to participants' characteristics in order to verify randomization, one-way ANOVA was used. In addition, repeated measures ANOVA was used to test the effect of training (on attention bias and anxiety symptoms) with the pre and post measures being the repeated factor and Group (2 interventions, placebo) as the between factor.

In addition, the moderating role of pre-existing type of AB[4] and state anxiety levels were evaluated separately. The attentional bias measured with eye-tracking pertained to the total dwell time of faces presentation (6000ms). Specifically dwell time to the neutral area of interest was subtracted from dwell time to the threatening area of interest at pre-treatment. A positive number was considered as an index of difficulty of disengagement

(n=36) from threat and a negative number was considered as avoidance (n=36)[5]. With regards to the cutoff score of pre-existing state anxiety levels scores above the mean were considered as high state anxiety (n=36) and scores below the mean were considered as low state anxiety (n=46) (M=45, SD=5)[6].

After the data screening conditions of univariate and multivariate normality, sphericity, homogeneity of variance / covariance, multicollinearity as well as linearity were fulfilled. Therefore, there is no violation of certain conditions and the following results can be interpreted without any caution.

Finally, based on Alon et al., 2019 in order to achieve a power of 0.80 with α=0.05, two tailed and obtain the smallest effect found in previous studies (d=0.58, Schmidt et al., 2009) a sample size of 26 participants is indicated. Therefore, the current study represents an appropriate sample size in order to capture treatment effectiveness.

Data Reduction

For eye-tracking 1% of data were statistically significant outliers which were removed. For the Posner task, incorrect answers were removed (the probe was presented on the left and participants pressed the right button) as well as RT lower than 50ms and greater than 1200ms based on Amir et al., (2003) leading to 1% of data removal. The same amount of data was removed for physiological measures as they were considered statistically significant outliers. For the self-report measures 0.1% of data were statistically significant outliers which were removed, as well as 0.5% of behavioural measures.

Results

Group Equivalence

Preliminary analyses indicated no Group (2 interventions and placebo) differences at baseline in all the variables (see table 8-13 for all the statistical information).

<u>Experiment 2: pre to post-treatment</u>

Change in Attentional Bias (AB)

A 3 x 2 x 2 Repeated Measures ANOVA examined AB changes from pre to post treatment (Time) for both threat and neutral area of interest (Face valence) in eye tracking and Posner task indices based on Group (2 interventions: away and towards, placebo).

Eye-tracking data

AB eye tracking indices were a) dwell time (summation of the duration across all fixations) separately for angry and neutral faces for the whole time of 6000ms as well as for the time phases of 0-500ms, 500-1000ms and 1000-1500.

Dwell time 6000ms: Results showed no main effect of Time, F (2.66, 175) =0.82, p=0.47, no main effect of Group, F (2, 66) =0.08, p=0.92 and no statistically significant interaction between Group and Time, F (5.32, 175) =0.80, p=0.55.

Dwell time 0-500ms: Results showed a marginally statistically significant effect of Time, F (2.36, 149) =2.77, p=0.05, η^2=0.04. A separate analysis each type of faces, using a strict criterion of p=.025 for multiple comparisons was not statistically significant for angry faces, F (1, 64) =1.44, p=0.23 and marginally statistically significant for neutral faces, F (1, 65) =4.73, p=0.03, η^2=0.07. Examination of the means in the latter case showed that participants presented lower means of time spent looking neutral faces from pre (M=168, SD=3.56) to post-treatment (M=158, SD=3.62).

There was no main effect of Group, F (2, 63) =0.07, p=0.93 or interaction between Group and Time, F (4.73, 149) =0.15, p=0.98.

The remaining variables showed a non-statistically significant effect of Time: *Dwell time 500-1000ms, F* (2.53, 164) =2.39, p=0.08; *Dwell time 1000-1500ms, F* (2.25, 146) =1.73, p=0.18; Group: F (2, 65) =0.39, p=0.68; F (2, 65) =0.17, p=0.85; or interaction between Group and Time, F (5, 164) =0.74, p=0.60; F (4.50, 146) =1.31 respectively.

Posner task

AB indices from the Posner task were as a) reaction time (RT) for valid trials (the cue was presented at the same location of the face), b) reaction time (RT) for invalid trials (the cue was presented at the opposite location of the face).

Reaction time for valid trials: Results showed an effect of Time, F (1.45, 108) =19.47, p<0.001, η^2=0.21. A separate analysis for angry and neutral faces using a strict criterion of p=.025 for multiple comparisons was statistically significant for angry faces, F (1, 74) =36.47, p<0.001, η^2=0.33 and neutral faces, F (1, 75) =19.38, p<0.001, η^2=0.20. Results suggested that participants presented a decrease (i.e. faster) in reaction time towards valid angry trials from pre (M=388.80, SD=9.59) to post-treatment (M=346.91, SD=7.24) and neutral faces, from pre- (M=389.32, SD=10.33) to post-treatment (M=353.03, SD=7.97).

There was no main effect of Group, F (2, 75) =0.28, p=0.76 and no statistically significant interaction between Group and Time, F (3, 108) =1.47, p=0.23

Reaction time for invalid trials: Results showed an effect of Time, F (1.35, 101) =9.18, p<0.01, η^2=0.11. A separate analysis for both faces using a strict criterion of p=.025 for multiple comparisons was statistically significant for angry faces, F (1, 75) =8.98, p<0.01, η^2=0.11 and neutral faces, F (1, 75) =10.36, p<0.01, η^2=0.11. Results suggested that participants presented a decrease (i.e. faster) in reaction time towards invalid angry trials from pre (M=405.33, SD=7.31) to post-treatment (M=383.42, SD=7.90) and neutral trials, from pre- M=404.82, SD=10.31) to post-treatment (M=380.47, SD=7.82).

Results showed no main effect of Group, F (2, 75) =0.23, p=0.79 and no significant interaction between Group and time, F (2.70, 101) =1.40, p=0.25.

Difference between angry and neutral faces in RT

A 3 x 2 Repeated Measures ANOVA examined AB changes from pre to post treatment (Time) based on Group (2 interventions: away and towards, placebo). Within variable (Time) was measured with a) RT for valid cue angry faces trials minus RT for valid cue neutral faces trials, b) RT for invalid cue trials angry faces minus RT for invalid cue trials neutral faces.

Valid cue reaction trials

Results showed no effect of Time, F (1, 74) =0.54, p=0.47, Group, F (2, 74) =0.07, p=0.93, or Group x Time interaction, F (2, 74) =0.29, p=0.75.

Invalid cue reaction trials

Results showed no effect of Time, F (1, 75) =0.29, p=0.59, no effect of Group, F (2, 75) =0.05, p=0.95 and no significant interaction between Group and Time, F (2, 75) =1.14, p=0.33.

Social anxiety changes in self-report measures

A similar 3 x 2 Repeated Measures ANOVA examined social anxiety changes from pre to post treatment.

Results showed no effect of Time, no main effect of Group, and no statistically significant interaction between Group and Time for *SPAI_diffscore:* Time, F (1, 76) =1.35, p=0.25, Group, F (2, 76) =0.70, p=0.50, Group and Time, F (2, 76) =0.54, p=0.58; *PDSQ_SAscale*: Time, F (1, 76) =0.59, p=0.44, Group, F (2, 76) =2.43, p=0.09, Group and

Time, F (2, 76) =0.92, p=0.40; and *Liebowitz_SA*: Time, F (1, 75) =0.01, p=0.94, Group, F (2, 75) =0.10, p=0.90, Group and Time, F (2, 75) =0.31, p=0.74.

Behavioural measure changes

A similar 3 x 2 Repeated Measures ANOVA examined behavioral (self-perceived) anxiety changes from pre to post treatment.

Self-assessment of participants' speech: Results showed an effect of Time, F (1, 75) =15.95, p<0.001, η^2=0.17 indicating that participants reported a more positive evaluation of their speeches from pre (M=37.62, SD=1.05) to post-treatment (M=41.19, SD=1.01). There was no main effect of Group, F (2, 75) =0.72, p=0.49 and no statistically significant interaction between Group and Time, F (2, 75) =0.48, p=0.62.

Report of maximum Subjective Unit of Distress during the speech: Results showed an effect of Time, F (1, 68) =24.30, p<0.01, η^2=0.26 with participants reporting a decrease in the maximum levels of anxiety during the speech from pre (M=7.28, SD=0.27) to post-treatment (M=5.75, SD=0.31). There was no main effect of Group, F (2, 68) =0.06, p=0.94 Group x Time interaction, F (2, 68) =0.95, p=0.39.

Somatic symptoms – physiological measures changes

Repeated Measures ANOVA examined the intervention's effectiveness with the Group as the between subject variable with three levels (2 interventions, placebo) and Time with two levels (pre-treatment, post-treatment) during the speech.

<u>Heart rate (HR)</u>

Results showed an effect of Time, F (1, 75) =7.13, p<0.01, η^2=0.09 indicating that participants presented a decrease of HR during the speech from pre (M=92.93, SD=1.47) to post-treatment (M=89.70, SD=1.50). There was no main effect of Group, F (2, 76) =0.79, p=0.46 and no statistically significant interaction between Group and Time, F (2, 76) =0.35, p=0.70.

<u>Skin conductance (SC)</u>

Results showed no effect of Time, F (1, 75) =2.02, p=0.16 and no main effect of Group, F (2, 75) =2.42, p=0.97 in SCR. In addition, no statistically significant interaction was found between Group and Time, F (2, 75) =0.16, p=0.85.

<u>Corrugator</u>

Results showed no effect of Time, F (1, 63) =2.84, p=0.09 and no main effect of Group, F (2, 63) =0.82, p=0.44 in Corrugator. Most importantly there was a statistically significant interaction between Group * Time, F (2, 63) =3.10, p=0.05, η^2=0.09.

With regards to the statistically significant interaction of Group * Time, results show that there was a decrease of corrugator reaction in both intervention Groups, which happened at different rates for each group. Specifically, training towards threat was M=4.07 (SD=0.67) at pre-treatment and decreased M=3.64 (SD=0.46) at post-treatment. Mean corrugator for the group receiving training away from threat was M=5.65 (SD=0.63) at pre-treatment and decreased M=3.64 (SD=0.43) at post-treatment. However, corrugator reaction was stable from pre to post treatment for the placebo group, M=4.16 (SD=0.67) to M=4.55 (SD=0.46). Simple effects of Group with Bonferroni correction for multiple comparisons showed that the 3 Groups did not differ neither at pre-treatment level, F (2, 63) =1.89, p=0.16 nor at post-treatment level, F (2, 63) =1.32, p=0.27. Simple effects of Time with Bonferroni correction for multiple comparisons showed that only the corrugator reduction from pre- to post treatment for the condition of training away from threat group was statistically significant F (1, 63) =8.92, p<0.01, η^2=0.12 and not for training towards threat F (1, 63) =0.36, p=0.55 and placebo group F (1, 63) =0.29, p=0.59 (see table 14 and Figure 5).

Moderators of treatment effectiveness

Type of pre-existing AB (difficulty of disengagement, avoidance) as moderator of intervention changes

Repeated Measures ANOVA examined the intervention's effectiveness on threat bias, social anxiety, behavioural measures and somatic symptoms separately with the Group (2 interventions, placebo) and type of pre-existing AB (PAB; difficulty of disengagement, avoidance) at pre-intervention as an additional between subject variable with two levels and Time as the within subject variable with two levels (pre-treatment and post-treatment).

PAB as a moderator yielded statistically significant results only for Corrugator. These results are presented below. The remaining non-statistically significant results are presented in table 15.

<u>Corrugator (COR)</u>

Results showed a statistically significant three-way interaction of Group x PAB x Time, F (2, 53) =4.78, p=0.01, η^2=0.15. Follow-up analyses separately for each group using a strict criterion of p=.025 for multiple comparisons showed a non-statistically significant interaction of PAB x Time on corrugator speech scores from pre- to post-treatment with regards to training towards threat, F (1, 17) =0.11, p=0.74 and placebo group, F (1, 18) =0.09, p=0.77. However, there was a significant interaction for training away from threat, F (1, 18) =9.25, p<0.001, η^2=0.35. Results show that avoiders had higher corrugator reaction from pre (M=8.30, SD= 1.35) to post-treatment (M=3.01, SD=0.63). In addition, those with difficulty of disengagement presented a decreased corrugator reaction from pre (M=4.03, SD=1.10) to post-treatment (M=3.93, SD=0.52) (see table 15). Simple effects of PAB with Bonferroni correction for multiple comparisons showed that the 2 groups differed at pre-treatment level, F (1, 18) =6.02, p<0.05, η^2=0.25 and not at post-treatment level, F (1, 18) =1.25, p=0.27. Simple effects of Time with Bonferroni correction for multiple comparisons showed a significant difference from pre- to post-treatment for avoiders, F (1, 18) =16.01, p=0.001, η^2=0.47 and not for those with difficulty of disengagement from threat, F (1, 18) =0.02, p=0.93 (see table 16 and Figure 6).

State anxiety levels as moderator of threat bias

Repeated Measures ANOVA examined the intervention's effectiveness on threat bias, social anxiety, behavioural measures and somatic symptoms separately with the Group (2 interventions, placebo) and state anxiety levels (high state anxiety, low state anxiety) at pre-intervention as between subject variable with two levels and Time as the within subject variable with two levels (pre-treatment and post-treatment).

State anxiety did not enter any significant interactions with group and/or time, suggesting that it was not a significant moderator of any effects (see table 17 for statistics).

Discussion

The aim of the current study was to compare training away and towards threat and a placebo condition in order to investigate the role of different AB patterns on ABMT effectiveness. In addition, treatment effectiveness was measured in a variety of ways (self-reports, behavioral and physiological measures) aiming to fill the gap within existing studies, which measured ABMT effectiveness mostly with clinician and self-report measures. In contrast to hypotheses, generally, results showed no effectiveness of ABMT treatment. Self-reported levels of anxiety did not present a change after the intervention and even though a reduction in AB, behavioral measures of anxiety and heart rate from

pre- to post-treatment assessment was apparent, this was however not due to the effect of training. The only exception was the reduction of Corrugator from pre- to post-treatment, which was found only in the two training groups, in contrast to the placebo group. Follow-up analyses showed that this difference was significant only for the training away from threat group. Corrugator supercilii (frown) is defined as a behavioural indication of negative affect describing a defensive reaction to a phobic or unpleasant stimulus (Vrana & Gross, 2004). This is the first study which assessed the effect of ABMT on Corrugator reactivity showing that training away from threat is related with a reduction of negative affect during a social stressor, an effect that has not been found from training towards threat and placebo condition.

With regards to the moderators of treatment effectiveness the majority of results do not support effectiveness for ABMT, irrespective of the level of the examined moderators. The exception again was Corrugator during the speech. Specifically, this measure showed that training away from threat worked better than training towards threat and placebo for those who presented specific type of AB before the training. It seems that training away from threat worked better for avoiders than those with difficulty of disengagement, suggesting that treatment helped attentional avoiders in their perception of the situation (speech), which became less negative. This result was unexpected based on research hypothesis.

In contrast with the proposed hypotheses, these results suggest that ABMT is not helpful for the reduction of social anxiety and self-perceived stress under a stressor. However, the picture is different with regards to a behavioral somatic symptom of anxiety, and specifically to a facial communication measure. Results suggest that only training away from threat helps in the reduction of an index of anxiety, specifically a behavioral indication of negative valence. A question that arises is why only training away from threat had this effect? The answer of this question cannot be clearly obtained within this study. One tentative interpretation could be that training away from threat which trains the individuals to focus their attention to neutral faces may have had the side effect that these individuals learned that specific facial expressions to which they were exposed to more often i.e more relaxed faces, might be considered as a more socially appropriate as they were selectively reinforced by the task. The presence of a stressor during the training (probability to make a speech after training) created a similarity of training and assessment point which probably helped to evoke the learned reaction.

Whatever the reason for this result, i.e. that training away from threat works for negative valence reduction, it can be a promising finding: First, the reduction of negative affect may help socially anxious individuals to perceive social situations involving faces of others as less aversive, to tolerate such stressful situations more and be more willing to be involved in them. This comes in contrast to their typical, common reaction to avoid them (Albano & DiBartolo, 2007; Muhlberger, Wieser, & Pauli, 2008). Also, one of the symptoms of social anxiety is the fear to show anxiety symptoms to others out of fear that these can be negatively evaluated (APA, 2013). In comparison to the other two physiological measures (skin conductance and heart rate), corrugator reaction, is the one which can be observed by others; having a reduced facial communication of fear may reduce the self-consciousness about apparent signals of anxiety experienced by socially anxious individuals and may also lead to a reduction of any negative feedback signals from others in response to sings of anxiety. Ultimately, both the willingness to engage with social situations, experienced as less aversive, and the improved facial communication while engaging with them may help break the vicious cycle of anxiety, self-consciousness and avoidance that helps maintain social anxiety. Notably, these potential changes, do not require a change in perceived anxiety, or autonomic arousal, which did not significantly change here.

Supporting the above mentioned explanation, based on Rappee & Heimberg's, (1997) social anxiety model, feedback from others' reaction e.g. a frown face and physical symptoms of anxiety are used by the socially anxious individuals as a way to compare how they should appear to others in comparison of how they think they appear in reality. Therefore, a lower behavioral indication of negative affect (frown) during the speech may lead to a more positive self-perceived image and to a probable more positive evaluation of the speaker by the crowd e.g. as showing more appropriate behavior during the speech. These in turn may be perceived as more positive feedback by the speaker, which may lead to less anxiety. Indeed, a facial expression seems to create judgments from others about individual's affective state, behavioral traits and tendencies and in return affects others' reaction towards the individual (Montepare & Dobish, 2003; Zebrowitz, Kikuchi, & Fellous, 2007; Zebrowitz & Montepare, 2008).

In addition, supporting more the above mentioned usefulness of this result, based on the mimicry effect (Dimberg, 1982; Dimberg et al., 2002), when individuals are exposed to positive or negative facial expressions, they tend to imitate spontaneously the corresponding reaction (Dimberg, 1982; Dimberg et al., 2002). Therefore, someone could

argue that when a socially anxious individual makes a speech in front of a crowd and being the focus of attention, a negative facial expression that this person has can create this mimicry reaction from others, and in turn the crowds' expression can affect back the speaker's expression, as a threatening facial expression is considered as a sign of rejection and disapproval from others (e.g. Ohman, 1986). It has been found that socially anxious individuals tend to 'overdo' this mimicry because of heightened interpersonal sensitivity (Dimberg & Thunberg, 2007). Therefore, training away from threatening faces may impact the perception or expectation of the likelihood of such negative expressions in social situations.

In this study, avoiders had higher Corrugator reaction at baseline than those with difficulty of disengagement at pre-treatment level. This in concordance with studies showing that suppression can result in higher experience of negative emotion (Gross & John, 2003). Therefore, the reduction of negative emotion during a speech can be a positive outcome and may increase the possibility of those individuals to tolerate such as stressful situation. Even though a well-documented explanation cannot be given from the results of the current study about why training away from threat has as an effect the Corrugator reduction in avoiders, a hypothetical explanation of this interaction effect could be that their higher baseline Corrugator reaction had as a result a better learning of the opposite reaction e.g. a more relaxed and socially appropriate face reaction, which has been reinforced by the task. Nonetheless, to further consider the effect on corrugator, spurious effects of baselines or other confounds must also be ruled out. Therefore, when the effect of Corrugator baseline was examined as covariate of this relationship, results showed that this relationship remained significant in spite of the baseline measures of this reaction. One more tentative explanation could be that attention to a neutral face can be considered as an exposure for avoiders. So, in addition to training everyone (irrespective from existing AB) to focus more on neutral faces, the training had a greater impact on those who tend to avoid perhaps even the neutral faces, through exposure, which "neutralized" the aversiveness of these faces.

An alternative explanation with regards to Corrugator reduction in attentional avoiders can be given based on the vigilance-avoidance model which suggests that attention is initially and preconsciously allocated to searching for threat e.g. a frowning face and once the danger is detected it is subsequently avoided (Mogg et al., 2004). In this study, PAB used as moderator of treatment effectiveness was measured at 6000ms. Participants identified as avoiders, may actually have initially presented vigilance which

turned to avoidance at the later stage. For this reason, training away from threat may helped in the reduction of their initial vigilance. However, this explanation does not look as convincing as no AB changes were found from pre- to post-treatment measured by 2 attentional tasks. As another tentative explanation, someone could argue that training away from threat may have turned attentional avoiders into even more effective avoiders. However, this is not supported by the overall results: Attentional Avoidance, self-perceived stress and other measures of sympathetic and parasympathetic system did not produce any differences from pre- to post-treatment, so that even if avoidance was reinforce it would not have produced the desired effects of reduced anxiety.

Results of the current study mostly show that ABMT training does not work for everybody and provide some potential explanations as to why this may be the case. Findings are in concordance with the results of previous studies showing negative findings, which had suggested that participants with limited attentional biases toward threat do not present with gains in self-reports and clinician measures in comparison to control groups undergoing ABMT (Amir, Taylor, & Donohue, 2011). It is worth noting that in the current sample most of the participants presented similar Reaction Time and dwell time towards threatening and neutral faces leading to the impression of not presenting AB at pre- test. Based on the above, one of the reasons of no statistically significant results of this study on most measures except Corrugator maybe is that most of the participants presented limited AB. In addition, another reason of treatment non-effectiveness may be related to the fact that the sample was comprised by non-treatment seekers and the study was not advertised as a treatment of social anxiety (as explained in previous experiment).

Generally, this study supports the non-effectiveness of ABMT in reducing AB and as a result anxiety and it is in accordance with other studies that found no differences between the training and placebo group with regards to self-report and behavioral measures of social anxiety following the AB treatment (Bunnell, Beidel, & Mesa, 2013; Maoz et al., 2013). However, this study is in disagreement with other studies which showed effectiveness of ABMT (e.g. Lazarov et al., 2018; Schmidt, Richey, Buckner, & Timpano, 2009), including the only other study which assessed anxiety levels using physiological measures and specifically skin conductance (Heeren et al., 2012). An important effect was found here with regards to the physiological measure of corrugator supercilii. It seems that the training away from during the speech presented less frown reactions at post-treatment in comparison with pre-treatment. Interestingly training away from threat seems to work better for Corrugator reaction with a specific pre-existing AB. Training away from threat

worked better for avoiders in reducing their negative affect reaction. This result might help socially anxious individuals to cope during the stressful situation of a speech, especially for avoiders who tend to present higher negative emotions during these social situations.

This study needs to be replicated in order to examine the effect of ABMT including the training towards threat group, even though this study found no effectiveness of this specific training. The examination of additional variables which may moderate its effectiveness needs to continue. For example, future research may need to investigate the assessment of AB in order to confirm its existence before participants receive the training and investigate what kind of training works for what kind of AB and under which circumstances securing enough power analysis to capture effects. Most importantly this study needs replication with regards to the negative affect reduction from training away from threat under a stressor; as it seems to be a useful finding which may improve the behaviour of socially anxious individuals under a stressor. It is essential to examine if this result can be replicated. Specifically, a replication of the study can show if this non-time consuming training can have such a positive impact and if it is possible to work better for specific attentional biases pattern. Finally, future research needs to provide answers regarding what might be the mechanism behind this effect and behind any positive effects of ABMT on various outcome measures more broadly.

Limitations

A closer investigation of studies which supported ABMT effectiveness show that treatment gains were mostly found in clinician administered measures (Lazarov et al., 2018; Schmidt, Richey, Buckner, & Timpano, 2009). This study did not use a clinician measure to assess anxiety levels at post-treatment. Moreover, with regards to treatment moderators the current sample of participants who presented attentional biases may not have had enough power to capture the treatment effectiveness and therefore any results about it should be interpreted as preliminary. In addition, all participants received assessment and training under state anxiety levels so this may not have helped to capture the effect of state anxiety as it might have if there was a comparison group under no stressor. Lastly, even though similar RT and dwell time to both types of faces (angry and neutral), is a result found previously as well (e.g. Amir et al., 200)3, for the current study the lack of a non-anxious comparison group prohibits a clear understanding with regards to the AB that these specific individuals present.

Footnotes

[1] No differences were found in treatment effectiveness of any measure between general social anxiety and the specifier of performance anxiety.

[2] Manipulation checks for state anxiety levels showed that speech was an appropriate stressor for participants, based on SUDS (M=7.50, SD=1.80) as the majority of participants presented SUDS rates above 7/10. Also, based on the state anxiety inventory participants presented enough anxiety levels (M=45, SD=5.45) as Mean state anxiety levels under high stress condition (presence of a stressor) seems to be around M=47 (e.g. Barnes, Harp & Jung, 2002)

[3] The following measures were examined with no significant contribution to the results: *first fixation latency*: the average latency of first fixations for each AOI. First fixation was defined as the first eye location lasting at least 100 ms after the initial cross fixation, b) *first fixation location*: number of times the first fixation was located in each AOI, c) *first fixation dwell time*: the average of first fixation duration for each of the AOI

[4] Dwell time variable which used as a moderator variable was analysed in 2 more ways: 1) Dwell time (6000ms) to the neutral area of interest was subtracted from dwell time to the threatening area of interest at pre-treatment. Half a standard deviation below the mean was considered as an index of avoidance and half standard deviation above mean was considered as an index of difficulty of disengagement from threat (M=3.26, ½ SD=31.14). The remaining participants were considered as having no pre-existing AB. Results were statistically significant in the same direction as presented at the current chapter; 2) Dwell time (500ms) to the neutral area of interest was subtracted from dwell time to the threatening area of interest at pre-treatment in order to capture automatic AB. A positive was considered as vigilance and a negative number was considered as an index of avoidance. All results were non-statistically significant showing that AB processes at 500ms do not moderate treatment changes at post-treatment.

[5] These 2 groups presented a pattern of difference (even though not statistically significant) in Corrugator reaction, State anxiety levels and Experiential Avoidance levels at pre-treatment. Avoiders scored higher than those with difficulty of disengagement in these 3 measures, supporting more this specific group separation.

[6] The moderator of state anxiety was scored and analyzed with two additional ways: 1) 1 standard deviation above the mean considered as high state anxiety and the remaining participants were considered as low state anxiety (M=45, SD=5), 2) 1 standard deviation above the mean considered as high state anxiety and 1SD below the mean considered as

low state anxiety, 3) The Subjective Unit of Distress during the speech was used alternatively as a variable of low and high state anxiety. All results were non-statistically significant.

CHAPTER 4

Prediction of attentional bias type under the presence of stressor and no stressor based on the trait characteristic of self-consciousness: The moderating role of social anxiety levels.

Abstract: Theory and research suggest that one of the etiological and maintenance factors of social anxiety (SA) is the existence of attentional biases (AB). The aim of this study was to examine the role of self-consciousness (SCS) and the moderating role of social anxiety levels in the explanation of different AB patterns existence both under no stressor and under stressor in socially anxious individuals. Results showed that under no stressor private self-consciousness predicts attentional avoidance. Social anxiety levels moderate this relationship and specifically this direction of results emerge under low SA; however, under high SA, private SCS predicts attentional vigilance. Under stressor there was no predictive relationship between SCS and AB types, and SA did not moderate these effects. Results are discussed with reference to different theoretical models (e.g. Eysenck et al., 2007) and support the need to further examine the hypothesis that different AB patterns can be explained by individual differences of socially anxious individuals.

Introduction

Attention refers to a cognitive process, which allows the brain to prioritize specific stimuli for elaboration (Shechner et al., 2012). Attentional biases (AB) in anxiety are attentional processes which interfere with normal stimulus processing. Many theoretical models refer to attentional biases (AB) as important processes which maintain anxiety (e.g. Bar-Haim et al., 2007; Eysenck, Derakshan, Santos, & Calvo, 2007; Matthews & Mackintosh, 1998; Mogg & Bradley, 1998; Ohman, 1996; Williams, Watts, MacLeod, & Mathews, 1988) and specifically social anxiety (e.g. Clark & Wells, 1995; Rapee & Heimberg, 1997). This belief has also been generally supported by research (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn, 2007).

Attentional biases include the processes of hypervigilance or vigilance to threat, attentional avoidance, and difficulty of disengagement from threat. More specifically, *hypervigilance* is the 'preference' of allocation of attention to threat relative to neutral stimuli (Bogels & Mansell, 2004; Cisler & Koster, 2010). This means that the threatening stimuli can be identified easier and quicker than the neutral (Cisler, Bacon, & Williams, 2009). *Attentional avoidance* of threatening stimuli is considered to happen when attention is directed away from threatening stimuli. Finally, *difficulty of disengagement* from threat

refers to a delayed withdrawal of attention from a threatening stimulus because of its ability to hold attention (Clarke, MacLeod, & Guastella, 2013).

In general, it seems well documented that individuals with social anxiety disorder (SAD) pay particular attention to social threatening information, including signs of disapproval from others (Amir et al., 2009; Pishyar, Harris, & Menzies, 2004) as well as to internal threat signals (Bögels & Mansell, 2004). In addition, there is some evidence that individuals with social anxiety have difficulties with disengagement of their attention from social threat (Amir, Elias, Klumpp, & Przeworski, 2003) and in some cases show attentional avoidance of threatening stimuli and social situations (Mogg, Bradley, Miles, & Dixon, 2004).

Given the above-mentioned findings, the vigilance-avoidance hypothesis was proposed (Mogg et al., 2004) in an effort to reconcile existing evidence regarding AB (at least with regards to vigilance and avoidance) in SAD. The vigilance-avoidance model suggests that attention is initially and preconsciously allocated to searching for threat e.g. a frowning face and once the danger is detected it is subsequently avoided (Mogg et al., 2004). Looking at the literature more broadly, it is not clearly evident when exactly, i.e. at what time point this happens and what variables contribute to whether individuals show vigilance or avoidance (Boettcher et al., 2013; Staugaard., 2010). In addition, it is unclear if everybody shows both vigilance and avoidance according to the time line proposed by Mogg et al, or if some individuals with SAD have a preference for one type of attention bias vs the other.

One possible group of variables that may contribute to whether an individual with SAD shows vigilance or avoidance may be related to specific individual differences in traits like tendency for being self-conscious/self-focused. Self-focused attention is the orientation of attention towards internal self-relevant stimuli (Bogels & Mansell, 2004). It has been proposed as one of the maintenance factors of social anxiety, which indicates that some degree of it characterizes all individuals with SAD (e.g. Clark & Wells, 1995; Rapee & Heimberg, 1997). Self-focused attention refers to the momentary shift of attention towards the self, i.e. it is a state. However, some people have a dispositional tendency towards self-focused attention. This trait-like form of self-focus is called self-consciousness and is divided into private and public self-consciousness (Panayiotou, 2005). Private self-consciousness is the awareness of internal stimuli such as thoughts and feelings and public self-consciousness is the examination of the self, as a social object which has effect on others (Bogels & Mansell, 2004; Fenigstein, Scheier, & Buss, 1975).

Social anxiety has been found to positively correlated with self- consciousness (Bogels, Alberts, & de Jong, 1996; Perowne & Mansell, 2002).

Based on the *Cognitive model of social phobia* (Clark & Wells, 1995) socially anxious individuals show self-focused attention and avoidance of external stimuli e.g. eye-contact (which could be interpreted as attentional avoidance). According to this model, attention is turned inwards for example towards ones' increased heart rate, and self-evaluative thoughts while in a social situation, instead of on external stimuli of the situation itself. This type of self-focused attention interferes with the ability to process social cues, which may lead to errors in social behavior (e.g. failing to remember people's names that one meets) that may be perceived as failure. These experiences of perceived failures lead to increased anxiety about social situations perpetuating a vicious cycle.

However, other models e.g. Rapee & Heimberg, (1997), talk about attentional allocation to perceived external threat as well as to internal threat cues in order for socially anxious individuals to collect information about of how they might appear to others. Other models e.g. Attentional Control theory (ACT; Eysenck et al., 2007), which refer to the trait characteristic of anxiety in general (and not specifically to social anxiety) also describe attentional allocation in both external and internal stimuli in anxious individuals. For this specific model the explanation which is given is based on disruption at the attentional control system of anxious individuals. This disruption is related with an increase of stimulus driven attention, therefore threatening stimuli (either internal or external) capture attention and decrease of top-down regulatory control (goal driven attention).

Therefore, models tend to present different information on the relationship between the state characteristic of self-consciousness (self-focused attention) and AB types. On the one hand, it is possible that socially anxious individuals with elevated tendencies towards self-consciousness would have less of a tendency or ability to show vigilance towards external threatening stimuli, which would look like an avoidance pattern e.g. Clark & Wells (1995) model, compared to those lower on this trait. On the other, it is possible for these individuals to show more of a vigilant pattern of attention towards threatening stimuli either this stimulus is internal or external e.g. Eysenck et al., (2007); Rapee & Heimberg, (1997). In order to better understand attentional bias processes, in SAD, it would be important to examine the relationship between the tendency to focus on certain aspects of the self during social situations and attention biases to external stimuli. In its state form attention on the self reflects the construct of self-focused attention. Its trait form, i.e. the dispositional tendency towards self-focused attention is self- consciousness which can be

measured via the Self-consciousness scale (SCS; Fenigstein, Scheier, & Buss, 1975). Trait self-consciousness may modulate the degree of attention bias to threat.

In addition, social anxiety levels may contribute to the relationship between self-consciousness and AB. Currently, information from studies with regards to the role of social anxiety levels in determining the type of AB is not enough to draw conclusions, even though there is some tendency for individuals with high social anxiety levels to present attentional avoidance in comparison with low socially anxious participants under the presence of a stressor (e.g. Garner, Mogg, & Bradley, 2006; Helfinstein, White, Bar-Haim, & Fox, 2008; Mansell, Clark, Ehlers, and Chen, 1999). However, theoretical models which refer to attentional avoidance (Mogg & Bradley, 1998; 2016; Williams, Watts, MacLeod, & Mathews, 1988), describe it as characteristics of low anxious individuals. Therefore, the moderating role of social anxiety levels between self-consciousness and AB needs to be examined as it may change the relationship between them.

Another variable which needs to be examined with regards to the relationship between social anxiety and attentional biases is the presence of a stressor. Most of the studies which concluded that people with SAD show attentional avoidance appear to have some specific methodological characteristics compared to those that did not find avoidance effects, such as the presence of a state anxiety manipulation, for example a public speaking stressor (Amir et al., 1996; Bögels & Mansell, 2004; Shechner et al., 2012). State anxiety is the result of the presentation of a stimulus that produces anxiety (Pacheco-Unguetti, Acosta, Callejas, & Lupiáñez, 2010), during which individuals respond with the feeling of tension, worry, activation of the autonomous nervous system and avoidant or safety behaviors (Fountoulakis et al., 2006). To the contrary, trait anxiety is related to individual differences in anxiety proneness as a personality trait, or a 'predisposition' which leads to a tendency for elevated anxiety across various stressful situations. Although trait anxiety is a characteristic of socially anxious individuals, the presence of state anxiety during the experimental situation may be required for certain AB effects to appear (Bögels & Mansell, 2004). Therefore, social anxiety may have a different interaction with individual differences in self-consciousness in the presence or absence of state anxiety with regards to the attentional processing patterns.

Current study

The goal of this study is to examine the relationship between self-consciousness and attentional biases and specifically whether in the presence of it there is a tendency for greater avoidance than vigilance. In addition, the current study aims to examine the

potential moderating role of social anxiety levels between self-consciousness and type of attentional biases. This study is comprised by two experiments. Specifically, these relationships were studied a) in the absence of the stressor (experiment 1) with AB measured by the dot-probe task and b) under state anxiety (presence of a stressor; experiment 2) with AB measured by eye-tracking in order to examine if different relationships can emerge under different conditions.

Research Hypotheses:

It was expected that a) both private and public self-consciousness would predict attentional biases in both experiments, b) social anxiety levels would moderate the relationship between self-consciousness and the type of AB, c) a different moderating relationship will be noted under a stressor and under no stressor direction. Because of the absence of relevant findings there are no specific hypotheses posed about the direction of these effects.

Experiment 1

Method

Participants:

Participants are descripted in chapter 2 (see page 22)

Procedure:

Participants initially completed the attention bias assessment through a dot-probe task and next they completed the self-report measures.

Measures:

Social Phobia and Anxiety Inventory-23 (SPAI-23; Roberson-Nay, Strong, Nay, Beidel, & Turner, 2007): this measure is descripted at page 25 and information about internal consistency can be found at table 2.

Self-consciousness scale (SCS; Fenigstein, Scheier, & Buss, 1975): It consists of 23 items and 3 scales which measure private self-consciousness (α=0.79), public self-consciousness (α=.084) and social anxiety (0.73). The first two scales assess if the individuals are focused on their inner processes (private SC) or if they focus on themselves as a social object (public SC) respectively. This measure was standardized in the Greek speaking population in a previous study (Panayiotou & Kokkinos, 2006) with good reliabilities. Only these 2 scales were used in the current study. Internal consistency for

experiment 1 was not adequate (Cronbach's alpha: SCS_private 0.18, SCS_public: 0.52) and therefore results should be interpreted with caution.

Attention bias measurement

The Dot probe attention task

This task is described in chapter 2 (page 27). The reliability of this task was questioned in some previous studies (e.g. Price et al., 2014). However, reliability of this measurement at the current sample was excellent: neutral-neutral trials Cronbach's alpha = 0.93, angry-neutral congruent trials Cronbach's alpha = 0.93, angry-neutral incongruent trials Cronbach's alpha = 0.93.

Data analysis

To predict AB type (vigilance or avoidance) based on self-consciousness multiple regression was used. Specifically, both private and public self-consciousness were used as predictors of AB. AB of either the vigilance type or the avoidance type was measured with the dot-probe task. Specifically the reaction time on stimuli which replace the threatening face when it is presented with non-threat (i.e., congruent trial) was subtracted from reaction time on stimuli which replace non-threat (neutral face) when it is presented with threat (angry face) (i.e., incongruent trial). A positive number reflects faster identification of threat. However, a negative score on AB reflects quick detection of neutral stimuli and it is interpreted as avoidance. For this analysis the continuous variable of the difference scores was used.

In addition, the moderating relationship of social anxiety levels (SPAI, SA subscale score) between self-consciousness and AB type (the same variable as above) was examined through the moderation analysis using the command process.spd.

Conditions of linearity and multivariate normality were met. In addition, the condition of multicollinearity was not violated.

Data Reduction

Information about the dot-probe task data reduction process is presented at chapter 2 (page 30). No outliers were found with regards to the self-report measure of SCS.

Results

<u>Self-consciousness as predictor of AB</u>

Multiple regression was calculated to predict participant's attention bias based on self-consciousness levels (SCS_public and SCS_private) A marginally significant regression equation was found, F (2, 58)=2.82, p=0.06 with an R^2 of 0.09. Results showed

that only SCS_private was a statistically significant predictor of AB, t= -2.34, p<0.05. Specifically, as SCS_private increased, there was a decrease of AB b=-2.02 , i.e. more avoidance. SCS_public, was not a significant predictor, t= 1.28, p=0.20.

The moderating role of social anxiety levels

A more specific examination of the above statistically significant result was accomplished through the moderation analysis using the command process.spd. The predictor variable was Private self-consciousness, the outcome variable was AB and the moderator variable was social anxiety (measured on SPAI SA subscale). The model was statistically significant, F (3, 55) = 8.78, p=0.0001 with an R^2 of 0.38. Results showed a statistically significant interaction, b=0.32 95% CI [0.17, 0.48], t=2.27, p=0.0001 (see table 18). Therefore, the relationship between private self-consciousness and attention bias is moderated by social anxiety levels. Specifically, at medium levels of the moderator (Mean; M=39, SD=10) the relationship between private self-consciousness and AB is negatively non statistically significant, b= -1.17, 95% CI [-2.40, 0.08], t= -1.88, p = 0.06. However, at low levels of the moderator (1 SD below Mean) there was a negative statistically significant relationship, b= -4.40, 95% CI [-6.57, -2.25], t= -4.09, p = .0001 and at high levels of the moderator (1 SD above Mean) there was a positive statistically significant relationship, b= 2.07, 95% CI [0.25, 3.88], t= 2.29, p < 0.05 (see Figure 7).

Discussion

The existence of attentional biases is considered as an important mechanism of development and maintenance in social anxiety. The aim of the present experiment was to examine if individual difference of self-consciousness could predict and social anxiety levels could moderate the AB patterns that socially anxious individuals present with regards to threat relevant stimuli. Results showed that public self-consciousness did not predict any AB type; in contrast with private self- consciousness which predicts greater attentional avoidance. However, when the moderating role of social anxiety between private self- consciousness and AB was examined results showed that different levels of social anxiety moderate this relationship. Specifically, individuals with the characteristic of private self- consciousness and low social anxiety levels tend to present attentional avoidance; in contrast those with this characteristic and high social anxiety levels tend to present attentional vigilance.

The findings of this study with regards to the prediction of AB based on self-consciousness is in concordance with the study's hypothesis. It seems that when socially

anxious individuals are focused on inner thoughts and feelings, they tend to avoid threatening stimuli. Interestingly, this is the case in lower social anxiety levels (keeping in mind that all participants were socially anxious). Several tentative explanations can be given for this finding. One possibility is that because it is difficult to focus both on inner and external stimuli due to limited attention resources, individuals without very severe social anxiety may pay less attention to external stimuli because they interpret them as less threatening than internal stimuli. Therefore, results partially support the Cognitive model of social phobia (Clark & Wells, 1995) as it seems that different social anxiety levels interact differently with self-consciousness with regards to the emergence of specific AB patterns. The moderation result regarding low levels of social anxiety is in concordance with theoretical models of Mogg & Bradley, 1998; 2016; Williams, Watts, MacLeod, & Mathews, 1988, which refer to attentional avoidance as being a characteristic of low anxious individuals.

The moderation analysis also showed that at high anxiety levels, the presence of private self-consciousness was related to attention to outwards stimuli. This finding seems paradoxical as it seems that higher internal focus of attention predicts greater vigilance. This result tends to support however the Cognitive-Behavioral model of anxiety of Rapee & Heimberg, (1997). This model talks about attentional allocation to both internal and external threatening stimuli in social anxiety. In addition, this finding may be consistent with attentional control theory (Eysenck et al., 2007), and specifically the increase of stimulus driven attention towards internal and external threat, which distracts individuals during a task (if we consider that at the dot-probe task participants were instructed to react to the probe, angry faces can be interpreted as distractors) due to attentional control deficits. However, conclusion cannot be drawn regarding attentional control deficits and the relationship with attentional biases as Attentional Control was not specifically measured. In the literature however though attentional control deficits have been found to be related with attentional biases (e.g. Taylor, Cross, & Amir 2016).

Experiment 2

Method

Participants:

Participants are descripted in chapter 3 (see page 44)

Procedure:

The procedure is descripted in chapter 3 (see page 45)

Measures:

Measures of experiment 2 are the same as those of experiment 1.

Information about internal consistency can be found in table 7 for SPAI. Internal consistency of the SCS was not adequate for Experiment 2 (Cronbach's alpha: SCS_private 0.47, SCS_public: 0.60) and therefore results should be interpreted with caution.

Attention bias measurement

Eye-tracking

This task is descripted in chapter 3 (page 48). It presented excellent reliability in previous studies (e.g. Lazarov et al., 2016).

Data analysis

To predict attention towards a threatening stimulus based on self-consciousness multiple regression was used. Specifically, both private and public self-consciousness were used as predictors of AB. AB was measured with eye-tracking. The dwell time measured at 500ms[l] on neutral area of interest was subtracted from the dwell time on threatening area of interest. A positive number reflects faster identification of threat for 500ms. However, a negative score reflects quick detection of neutral stimuli and it is interpreted as avoidance of the threatening interest area. For this analysis the continuous variable of difference score was used.

In addition, the moderating relationship of social anxiety (SA subscale of SPAI) between self-consciousness and AB type was examined through moderation analysis using the command process.spd.

Conditions of linearity and multivariate normality were met. In addition, the condition of multicollinearity was not violated.

Data Reduction

Information about eye-tracking data reduction is presented in chapter 3 (page 51). No outliers were found with regards to self-report measure of SCS.

Results

<u>Self-consciousness as predictor of AB</u>

Dwell time on angry faces

Multiple regression was calculated to predict participant's attention bias for the time interval of 0-500ms based on self-consciousness levels (SCS_public and SCS_private). However, a non-significant regression equation was found, F (2, 73) =1.34, p=0.27.

The moderating role of social anxiety levels

An examination of the moderating relationship of social anxiety levels between private self-consciousness and AB showed a non-statistically significant model, F (3, 71) =0.67, p=0.57. The same non-statistically significant results were found with public self-consciousness as a predictor, F (3, 70) =1.36, p=0.27.

Discussion

Theory and research suggest that one of the etiological and maintenance factors of social anxiety is the existence of attentional biases. The aim of the present study was to examine if individual differences could predict AB patterns of socially anxious individuals. Specifically, the role of self-consciousness was examined. In addition, this study examined the moderating role of social anxiety levels. Results showed no relationship between self-consciousness and attentional vigilance or avoidance. The same non-statistically significant relationship was found when the moderating role of social anxiety levels between self-consciousness and AB was examined.

The findings of this study with regards to the prediction of AB based on self-consciousness is not in concordance with the study's hypotheses and findings of the previous experiment which were supported by models of anxiety (Clark & Wells, 1995; Eysenck et al., 2007; Rapee & Heimberg, 1997). It seems that the characteristic of self-consciousness in socially anxious individuals does not affect attentional processes towards or away from external stimuli under a stressor condition, an unexpected result.

Based on Eysenck et al., (2007) attentional control theory, top-down processes are negatively affected in anxious individuals and stimulus driven attention is the one which prevails. For the current experiment, which was done under a stressor, there was probably a conflict between stimulus driven attention (lack of attentional control) and top-down processes (goal driven attention), as participants felt that they had more motivation to be alert for probable external threats because of the presence of the stressor. For this reason, under state anxiety the characteristic of self- consciousness does not affect attentional bias as participants might be more driven to pay attention to the task, including threatening information, no matter their internal feelings. Therefore, self-consciousness under stressful

conditions might not predict AB type and other characteristics (beyond of the study's scope) might play a role in the prediction of AB types.

General Discussion

The aim of this study was to examine the role of self-consciousness and the moderating role of social anxiety levels in the explanation of different AB patterns. The first experiment which was done under no stressor conditions showed that private self-consciousness predicts attentional avoidance. However social anxiety levels moderate the relationship between private self- consciousness and AB. Specifically the combined effect of private self- consciousness and low social anxiety levels predict attentional avoidance, whereas the combined effect of private self- consciousness and high social anxiety levels predict attentional vigilance. The second experiment which was done under state anxiety conditions showed no relationship between self- consciousness and attentional biases.

Results under the no stressor experiment support models which refer to internal focus of attention as an explanation why social stimuli difficult to pay attention to (Clark & Wells, 1995).However, the above effect is significantly moderated by anxiety level predicting different attentional biases (attentional vigilance under high social anxiety levels) probably supporting models such as Rapee & Heimberg, (1997) and Attentional Control theory (Eysenck et al., 2007). However, under the stressor there is a different picture with no relationship between self-consciousness and attentional bias. Therefore, this study shows that the context e.g. the presence of a social stressor, might play an important role as it seems that different processes play a role under stressor and no stressor in the prediction of AB patterns.

Examining the role of individual differences in different attentional patterns can inform practice for example attention bias modification treatment (e.g. Bar-Haim, 2010), as well as the evidence based-treatment of cognitive behavioral therapy for social phobia (e.g. Price, Tone, Anderson, 2011). Specifically, based on the current results different levels of social anxiety in combination with the characteristic of self- consciousness might need different techniques which refer to attentional processes. This is the first study which examined these individual differences and their role in attentional processes. The current findings support the need to examine more the hypothesis that different AB patterns can be explained by individual differences within socially anxious individuals and specifically to examine in greater detail the role of self-consciousness. First, these results need to be replicated. Secondly, research is needed to understand the mechanism of the relationship

between self-consciousness and attentional control in the prediction of AB types. In addition, an examination of the possibility that different individual characteristics are related with the AB patterns under the presence of a stressor, in comparison with no stressor needs to be done as well as an examination of what these characteristics might be.

Limitations and future directions

Due to the cross-sectional nature of the study, causal inferences cannot be made. In addition, in experiment 1 AB were measured with the dot-probe, which, even though it is the most well-known task for its purpose, recently some studies questioned its reliability (e.g. Price et al., 2014; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). AB in experiment 2 were measured with eye-tracking which is considered as the most accurate AB measurement (Bogels & Mansell, 2004). Because of the use of different indices, the comparison of these two experiments is difficult to do, which means that patterns of AB might have been consistent between the two experiments if more consistent measures had been used. Therefore, future studies should consider using the same AB measure under stressor and no stressor conditions. Moreover, almost half of the participants in both experiments present no strong AB as their levels were close to zero (difference in RT and dwell time between angry and neutral faces). Therefore, future studies should consider examining the role of individual differences in AB with participants presenting the same AB levels. The SCS questionnaire presented low reliability at the current sample, even though it has been standardized in a Greek speaking sample in Cyprus. The reason of this no good internal consistency for the current sample may have to do with the small sample size for this analysis. Lastly, as this study examined the role of trait characteristic of self-consciousness the examination of the state characteristic of it, self-focused attention, in an experimental manipulation needs to be addressed with regards again to the prediction of AB types.

Footnote

[1] For Experiment 2 the dwell time difference variable between threatening and neutral areas of interest in the time-interval of 6000ms was also used as the outcome measure as well as Posner task variables (valid and invalid cue difference between angry and neutral faces) with all analyses yielding non-statistically significant relationship with self-consciousness as the predictor variable.

CHAPTER 5

General Discussion

This study is comprised of two experiments both aiming to examine the effectiveness of Attention Bias Modification Treatment, taking into consideration the previous mixed results. In addition, both experiments examined moderators of ABMT effectiveness and specifically pre-existing AB and state anxiety levels in order to inform future studies, aiming to improve treatment effectiveness. The first experiment compared a training away from threat group with a placebo condition. In addition, it studied treatment effectiveness in a 6-month follow-up assessment. The second experiment compared training away from threat, training towards threat and the placebo condition taking into consideration the different AB patterns that socially anxious individuals present, e.g. if training away from threat works with participants who present attentional vigilance and if training towards threat works for attentional avoiders.

Moreover, state anxiety levels were manipulated at the second experiment during the assessment and during the training as they were presented under stressor (upcoming video recorded speech). State anxiety was also measured with self-reports in order to assess the effect that it might have on ABMT effectiveness. In addition, the specific experiment measured AB changes with 2 tasks (eye-tracking and Posner task) different than the one that participants received for training (dot-probe task). SA changes were measured with self-report, behavioural and physiological measures aiming to fill the gap in previous studies which measured SA changes mostly with self-report and clinician measures.

Both experiments support the non-effectiveness of ABMT. There were no AB and as a result no SA changes from pre- to post-treatment measured in all ways. In addition, pre-existing AB and state anxiety levels did not moderate treatment effectiveness in either of the two studies. However, a reduction of Corrugator responses during a speech task in experiment 2 was the only statistically significant result which it was apparent in the training away from threat group, only for avoiders. This result was unexpected based on research hypotheses. In addition, the mechanism explaining this result is not entirely clear but possible reasons for this finding are discussed. It seems to not be related to AB changes as there were no attentional changes from pre- to post-treatment. A possible explanation is

the possibility of this effect to be a learned response of these individuals to present a similar face reaction to the one that they were exposed to the most.

Why this learning was more facilitated in avoiders is another challenging question. This effect might have been apparent in the group with this specific PAB type probably because of the higher baseline Corrugator reaction that this group presented which might have facilitated more the learning of the relaxed face. Another possibility is that training towards neutral faces can be considered as an exposure for this specific group and therefore it reduces this type of face aversiveness.

The usefulness of this result is more evident in comparison with its possible mechanism. The reduction of negative affect is probably related with an increase of willingness for socially anxious individuals to participate and tolerate social situations. In addition, it might reduce their perceived negative image of themselves as anxious and at the same time the actual possibility to receive negative feedback from others during an anxiety provoking situation e.g. signs of perceived negative evaluation (Dimberg & Thunberg, 2007; Rappee & Heimberg's, 1997).

The current study in general supports previous studies which found no effectiveness of ABM treatment (Bunnell, Beidel, & Mesa, 2013; Maoz et al., 2013). The same time the examination of ABMT effectiveness needs to be further studied in the future for two reasons: 1) some previous studies support ABMT effectiveness (e.g. Lazarov et al., 2018; Schmidt, Richey, Buckner, & Timpano, 2009), 2) participants from this study presented limited pre-existing AB which it is considered as a reason that negatively affects ABMT effectiveness. This is one disadvantage that has been found in previous studies as well (e.g. Bunnell, Beidel, & Mesa, 2013; Maoz et al., 2013). One possible solution to this problem is the examination of AB levels (probably including also a non-anxious control group) before the training in order to confirm AB existence before participants receive the training. In addition, more studies need to take into consideration the different AB types that socially anxious individuals present and examine if specific kinds of training work better for specific types of population (assuming that one will have enough power of analyses to capture such effect).

With regards to the moderation role of state anxiety this study did not result in any indications that state anxiety levels might play a role for ABMT effectiveness. Nonetheless, more studies are needed to confirm or not this specific result. Future studies need to take into consideration this study's limitations and compare a group of participants

under a stressor with a group of participants under no stressor as this comparison can give a more clear picture of this result.

The third article of this study uses data from both experiments aiming to examine possible individual trait characteristics that might predict different AB types. Socially anxious individuals tend to present different AB types (Cisler & Koster, 2010) making AB contribution in social anxiety maintenance and therefore their need of modification even more complicated. In addition, models of anxiety tend to infer different information with regards to the relationship between the state characteristic of self-consciousness (self-focused attention) and external allocation of attention (e.g. Clark & Wells, 1995; Eysenck et al., 2007; Rapee & Heimberg, 1997). In this study, the trait characteristic of self-consciousness was examined as predictor of vigilance or avoidance. Social anxiety levels were examined as a moderator variable between self-consciousness and AB type. This examination was done both under no stressor (experiment 1) and under stressor (experiment 2).

Results from the first experiment (no stressor) showed that the characteristic of private self-consciousness predicts attentional avoidance. However, the combination of this characteristic with social anxiety levels modulates the results. Private self- consciousness and low SA levels still predict attentional avoidance; however, private self- consciousness and high SA levels predict attentional vigilance. Generally, public self- consciousness did not predict any AB type. In addition, for the second experiment (under stressor) neither private not public self-consciousness predicted vigilance or avoidance towards threatening faces nor SA levels moderated this relationship.

Therefore, results show that different social anxiety levels interact differently with the trait characteristic of private self-consciousness under no stressor. In addition, results in previous chapters are discussed based on different theoretical models (e.g. Eysenck et al., 2007) and the possibility of under high SA levels participants to present an increase of stimulus driven-attention (therefore both internal and external stimuli capture attention) and reduction of top-down processes (goal driven attention). With regards to the second experiment results under stressor were unexpected based on research hypotheses. In addition, the explanation of no relationship between self-consciousness and AB type is difficult to explain. One tentative explanation could be based on Eysenck et al., (2007) theory. Specifically, there was probably a conflict between stimulus driven attention (lack of attentional control) and top-down processes (goal driven attention), as participants felt

that they had more motivation to be alert for probable external threats because of the presence of the stressor.

Result from the third article show that different attentional processes are presented in socially anxious individuals based on the trait characteristic of private self-consciousness and social anxiety levels. This result shows that probably for specific population e.g. based on specific levels of characteristics, AB types contribute differently in the social anxiety maintenance. The same time, this result can inform back ABMT and other treatments of social anxiety. Specifically, based on the current results different levels of social anxiety in combination with the characteristic of self- consciousness might need different techniques to target specific attentional processes. The current findings support the need to examine further the hypothesis that different AB patterns can be explained by individual differences within socially anxious individuals and specifically to examine in greater detail the role of self-consciousness.

Generally, this research presents strengths and limitations. Starting with the strengths, this study aimed to fill gaps which are presented in the literature: 1) to examine moderators of ABMT effectiveness and understand what makes this type of training effective, 2) to provide information about the maintenance of treatment effectiveness, 3) to go beyond the typical training away from threat and investigate also the possible effectiveness of training towards threat, 4) to examine AB and SA with variable measurements, 5) to investigate predictors of AB in an effort to offer a better understanding in the field. With regards to the limitations of the study, results regarding the moderators of treatment effectiveness should be interpreted as preliminary due to the small sample size of this study to capture these effects. The same stands for the self-consciousness finding as a predictor of AB due to the low internal consistency that this measure presented in the current sample. Last, some of the participants' limited AB might have affected the possibility of finding statistically significant results. The way the study was advertised might also be related with non-treatment effectiveness, even though this may also provide information under which circumstances the training can be effective.

To summarize what we can learn from this study and starting with the most basic, one more study has been added in the literature finding no effectiveness to change AB after the ABM training. For this reason, no SA changes were found after any type of training. This study highlights even more the importance of finding moderators of treatment effectiveness. Future studies, should consider examining 1) if ABMT works for specific samples e.g. treatment seekers (as this sample was not comprised of treatment seekers), 2)

one more exclusion criteria needs to be added in ABMT studies and this needs to be the limited baseline AB, 3) if specific type of training is effective for specific AB types, 4) under which conditions e.g. presence of stressor or not, ABMT is effective for which type of training. Most importantly the literature about AB in social anxiety remains unclear regarding type of AB socially anxious individuals present. Therefore, trying to change a process that is not clearly defined makes the effort difficult and with many faults. This creates even more the need to understand the AB processes as this can lead to the creation of more effective protocols, something that may seem somewhat premature at this stage.

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APPENDICES

TABLES

Chapter 1

Table 1

Theoretical models

Attention processes described in current theoretical models

Attention processes	Models
Facilitated attention to threat AND Difficulty in Disengagement	Bar-Haim et al., (2007); Beck & Clark (1997); Eysenck et al. (2007); Rapee & Heimberg (1997);
Facilitated attention to threat	Matthews & Mackintosh (1998); Mogg & Bradley (1998); Ohman (1996); Wells & Matthews (1994); Clark & Wells, (1995) (self-focused attention);
Facilitated attention to threat in HTA AND attentional avoidance in LTA	Williams et al. (1988);
Attentional avoidance in HTA or high threat	Mogg & Bradley (1998; 2016);

Table 2

Internal consistency

	Cronbach's alpha		
Measure	Pre-treatment	Post-treatment	Follow-up
SPAI_ SA subscale	0.90	0.93	0.96
SPAI_ AG subscale	0.85	0.86	0.86
PDSQ_SAscale	0.80	0.87	0.76
Liebowitz_SA	0.95	0.96	0.97
State_Anxiety	0.20	0.14	0.51

Note: SPAI_ SA subscale= Social Phobia and Anxiety Inventory Social Anxiety subscale, SPAI_ AG subscale= Social Phobia and Anxiety Inventory Agoraphobia subscale, PDSQ_SAscale= Psychiatric Diagnostic Screening Questionnaire Social Anxiety scale, Liebowitz_SA= Liebowitz Social Anxiety Scale Test, State_Anxiety= State-Trait Anxiety Inventory State sub-scale.

Table 3

Group equivalence data

	Group	
Variable	Intervention (N=32)	Placebo (N=28)
Threat bias	-0.98 (23.45)	7.10 (23.60)
SPAI_diffscore	33.87 (7.72)	30.18 (8.52)
PDSQ_SAscale	7.64 (3.47)	7.43 (3.08)
Liebowitz_SA	66.65 (26.22)	61.04 (24.43)
State_Anxiety	46.39 (4.75)	46 (4.25)

Note: values in parentheses represent Standard deviations. Threat bias= The reaction time on stimuli which replace the threatening face when it is presented with non-threat (i.e., congruent trials) was subtracted from reaction time on stimuli which replace non-threat (neutral face) when it is presented with threat (angry face) (i.e., incongruent trials), SPAI_diffscore= Social Phobia and Anxiety Inventory difference score.

Table 4

Pre-existing AB as moderator

	Group x PAB x Time		
Variable	F	df	p
SPAI_diffscore	0.99	1, 51	0.32
PDSQ_SAscale	1.71	1, 51	0.20
Liebowitz_SA	1.04	1, 45	0.31

Table 5

State anxiety levels as moderator

	Group x State x Time		
Variable	F	df	p
Threat bias	1.10	1, 45	0.30
SPAI_diffscore	0.01	1, 45	0.93
PDSQ_SAscale	0.72	1, 45	0.40
Liebowitz_SA	0.20	1, 40	0.65

Table 6

Group equivalence for follow-up data

	Group	
Variable	Intervention (N=16)	Placebo (N=14)
Threat bias	3.08 (23.74)	12.06 (23.24)
SPAI_diffscore	34.50 (7.78)	32.15 (9.38)
PDSQ_SAscale	7.31 (3.42)	6.93 (2.62)
Liebowitz_SA	59.42 (24.82)	61.58 (26.34)

Note: values in parentheses represent Standard deviations.

Table 7

Internal consistency

	Cronbach's alpha	
Measure	Pre-treatment	Post-treatment
PSP_self	0.62	0.56
SPAI_ SA subscale	0.90	0.92
SPAI_ AG subscale	0.85	0.86
PDSQ_SAscale	0.79	0.75
Liebowitz_SA	0.93	0.59
State_anxiety	0.47	0.04

Note: PSP_self = Public-speaking performance measure self-assessment.

Table 8

Demographics Group equivalence data

				Group		
Variable	F	Df	P	Intervention (away)	Intervention (towards)	Placebo
Age	0.03	2, 79	0.97	20.31 (2.52)	20.30(1.52)	20.18(2.00)
Education	1.30	2, 81	0.28	2.38 (0.94)	2.79 (1.10)	2.34 (1.24)
Presentations	1.12	2, 75	0.33	3.75 (3.68)	4.67 (4.45)	3.07 (2.85)

Note: values in parentheses represent Standard deviations. Education= years of education at the University, Presentations= number of presentation they had to give at the University.

Table 9

Eye-tracking data				Group equivalence data		
					Group	
Variable	F	Df	P	Intervention (away)	Intervention (towards)	Placebo
Dwell 6000 (A)	1.11	2,77	0.60	2342 (221)	2448 (440)	2325 (256)
Dwell 0-500 (A)	0.11	2, 75	0.89	169 (34)	173 (29)	170 (30)
Dwell 500-1000 (A)	1.83	2, 76	0.17	398 (40)	386 (99)	408 (43)
Dwell 1000-1500 (A)	0.69	2, 76	0.50	615 (67)	594 (112)	592 (65)
Dwell 6000 (N)	0.69	2, 77	0.50	2256 (244)	2376 (491)	2352 (404)
Dwell 0-500 (N)	2.05	2, 76	0.27	164 (32)	178 (32)	163 (24)
Dwell 500-1000 (N)	1.83	2, 76	0.17	376 (48)	370 (71)	400 (88)
Dwell 1000-1500 (N)	1.84	2, 76	0.50	573 (60.5)	567 (75)	619 (86)

Note: values in parentheses represent Standard deviations. Dwell 6000 (A); Dwell 0-500 (A); Dwell 500-1000 (A); Dwell 1000-1500 (A)= summation of the duration across all fixations for angry interest area in different time windows, Dwell 6000 (N); Dwell 0-500 (N); Dwell 500-1000 (N); Dwell 1000-1500 (N)= summation of the duration across all fixations for neutral interest area in different time windows.

Table 10

Posner data				Group equivalence data		
				Group		
Variable	F	Df	P	Intervention (away)	Intervention (towards)	Placebo
RT valid trials (A)	0.04	2, 80	0.96	389.4 (67.9)	383.3 (89)	389.2 (91.7)
RT invalid trials (A)	0.33	2, 80	0.72	413.2 (66.3)	393.2 (97.5)	405.1 (102.7)
RT valid trials (N)	0.03	2, 80	0.97	388.8 (67.3)	384.7 (85.9)	391 (109.9)
RT invalid trials (N)	0.26	2, 80	0.77	413.2 (66.6)	396.1 (101.4)	401.1 (98.2)

Note: values in parentheses represent Standard deviations. RT valid trials (A)= the cue is presented at the same location of the angry face, RT invalid trials (A)= the cue is presented at the opposite location of the angry face, RT valid trials (N)= the cue is presented at the same location of the neutral face, RT invalid trials (N)= the cue is presented at the opposite location of the neutral face.

Table 11

Social anxiety self-report — Group equivalence data

				Group		
Variable	F	Df	P	Intervention (away)	Intervention (towards)	Placebo
SPAI_diffscore	0.42	2, 81	0.66	28.93 (7.77)	26.87 (6.72)	28.59 (10.55)
PDSQ_SAscale	2.82	2, 81	0.07	7.72 (2.96)	5.62 (3.80)	6.37 (3.12)
Liebowitz_SA	0.62	2, 80	0.54	70.75 (24.14)	68.65 (24.27)	64.24 (19.45)

Note: values in parentheses represent Standard deviations. SPAI_diffscore= Social Phobia and Anxiety Inventory difference score, PDSQ_SAscale= Psychiatric Diagnostic Screening Questionnaire Social Anxiety scale, Liebowitz_SA= Liebowitz Social Anxiety Scale Test.

Table 12

Behavioral measures of anxiety — Group equivalence data

				Group		
Variable	F	Df	P	Intervention (away)	Intervention (towards)	Placebo
Speech self-assessment	0.86	2, 81	0.42	36.06 (8.39)	39.33 (9.60)	36.96 (9.61)
SUDs speech (max)	0.38	2, 75	0.68	7.07 (2.00)	7.61 (2.31)	7.19 (2.42)

Note: values in parentheses represent Standard deviations. Speech self-assessment = Public-speaking performance measure, SUDs speech (max)= maximum Subjective Unit of Distress during the speech

Table 13

Physiological measures Group equivalence data

					Group	
Variable	F	Df	P	Intervention (away)	Intervention (towards)	Placebo
HR_speech	0.50	2, 80	0.61	88.38 (19.74)	94.58 (14.73)	91.54 (12.25)
SCR_speech	1.30	2, 80	0.28	11.03 (5.65)	12.61 (5.77)	9.96 (6.18)
COR_speech	1.63	2, 71	0.20	5.43 (4.13)	4.05 (2.03)	4.15 (2.10)

Note: values in parentheses represent Standard deviations. HR_speech= Heart rate during speech , SCR_speech= Skin conductance during speech, COR_speech= Corrugator during speech.

Table 14

Corrugator changes: Speech at pre-treatment in comparison with speech at post-treatment

					Time	
Group	F	Df	P	η^2	Pre-treatment M (SD)	Post-treatment M (SD)
	3.10	2, 63	0.05	0.09		
Training towards					4.07 (0.67)	3.64 (0.46)
Training away*					5.65 (0.63)	3.64 (0.43)
Placebo					4.16 (0.67)	4.55 (0.46)

Note: Training towards threat; Training away from threat; *The only statistically significant change: F (1, 63) =8.92, p<0.01, η^2=0.12.

Table 15

Type of Pre-existing Attention bias as moderator

Variable	F	Df	P
Valid diff. AN	0.99	2, 64	0.38
Invalid diff. AN	0.22	2, 64	0.80
SPAI_diffscore	0.49	2, 65	0.62
PDSQ_SAscale	0.31	2, 65	0.75
Liebowitz_SA	0.69	2, 64	0.51
Speech self- assessment	0.15	2,64	0.86
SUDs	0.61	2, 58	0.55
HR	0.51	2, 65	0.60
SC	1.70	2, 64	0.19

Note: Valid diff. AN= valid cue difference between angry and neutral faces, Invalid diff. AN= invalid cue difference between angry and neutral faces.

Table 16

Corrugator changes: Speech at pre-treatment in comparison with speech at post-treatment at training away from threat

					Time	
Group	F	Df	P	η^2	Pre-treatment M (SD)	Post-treatment M (SD)
	9.25	1, 18	<0.001	35		
Avoidance*					8.30 (1.35)	3.01 (0.63)
Diff. disengagement					4.03 (1.10)	3.93 (0.52)

Note: Diff. disengagement= difficulty of disengagement; *Corrugator change was statistically significant only for Avoiders, F (1, 18) =16.01, p=0.001, η^2=0.47.

Table 17

State anxiety levels as moderator

Variable	F	Df	P
Dwell 6000ms (A)	2.11	2, 63	0.13
Valid diff. AN	0.81	2, 72	0.45
Invalid diff. AN	1.19	2, 72	0.31
SPAI_diffscore	0.21	2, 73	0.81
PDSQ_SAscale	0.47	2, 73	0.63
Liebowitz_SA	2.48	2, 72	0.09
Speech self- assessment	1.10	2, 72	0.34
SUDs	0.01	2, 65	0.99
HR	0.17	2, 72	0.84
SC	1.34	2, 72	0.27
COR	0.27	2, 60	0.76

Note: Dwell 6000ms (A)= dwell time 6000ms for angry faces.

Table 18

Linear models of predictors of AB levels (Experiment 1)

	B	SE B	T	p
Constant	0.85	2.43	0.35	0.72
	[-4.02, 5.73]			
SA (centred)	0.55	0.23	2.42	0.02
	[0.09, 1.00]			
SCSprivate (centred)	-1.17	0.62	-1.88	0.07
	[-2.40, 0.08]			
SA x SCSprivate	0.32	0.08	4.16	0.0001
	[0.17, 0.48]			

Note: SA= SPAI SA subscale score, SCSprivate= Self-consciousness private subscale

FIGURES

Chapter 2 (Experiment 1)

Figure 1: Diagram of participants' progress through phases of the study

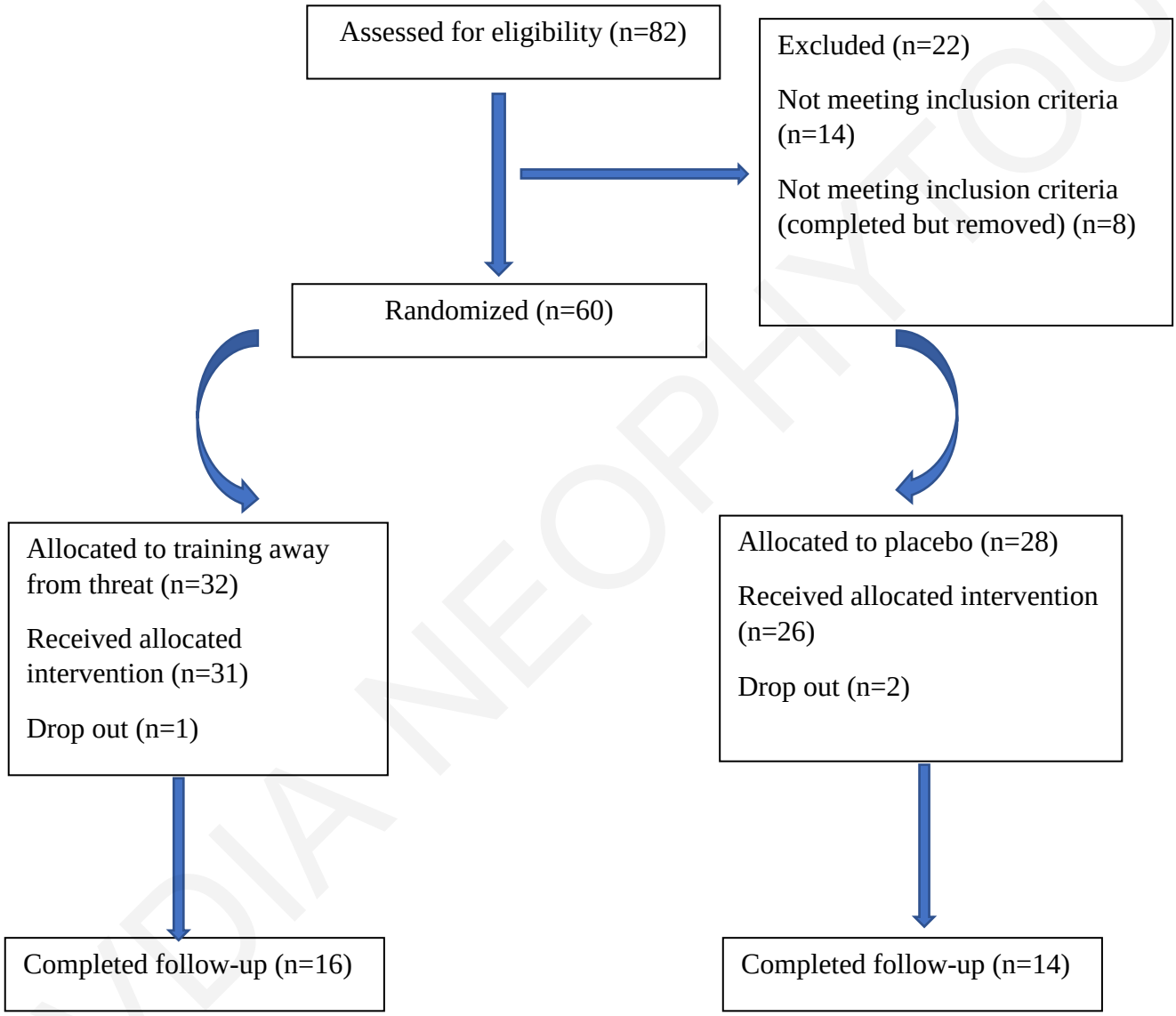

Figure 2: Dot-probe task example

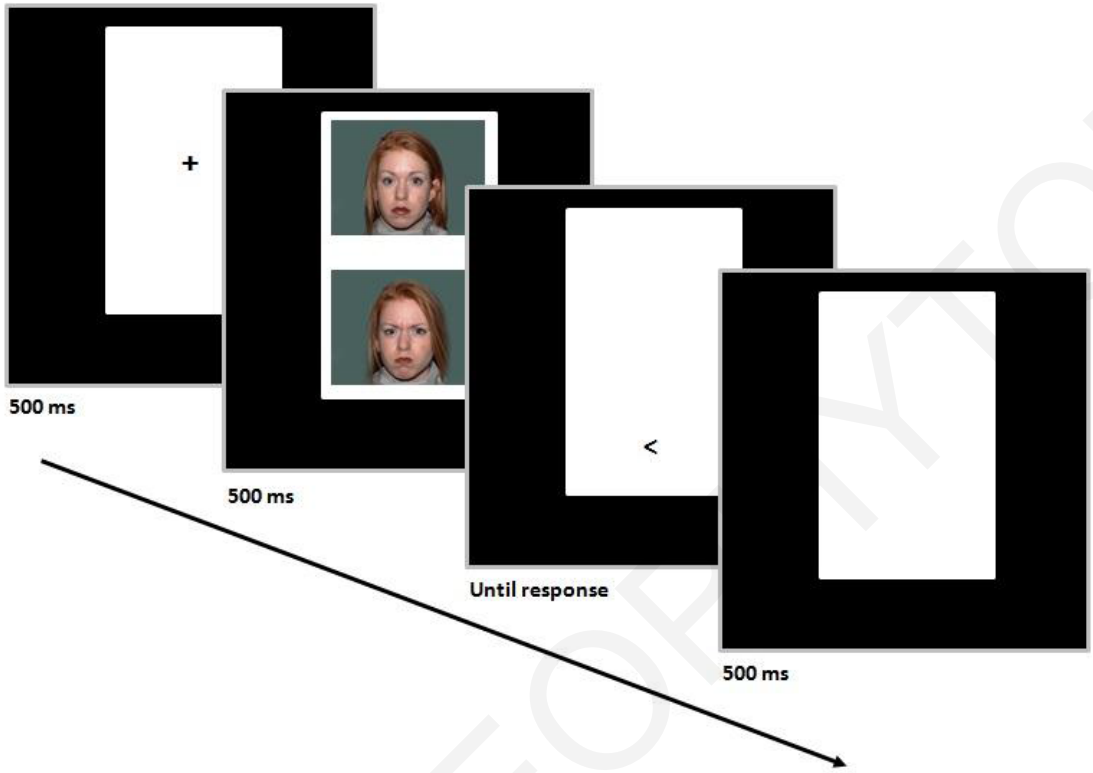

Figure 3: Diagram of participants' progress through phases of the study

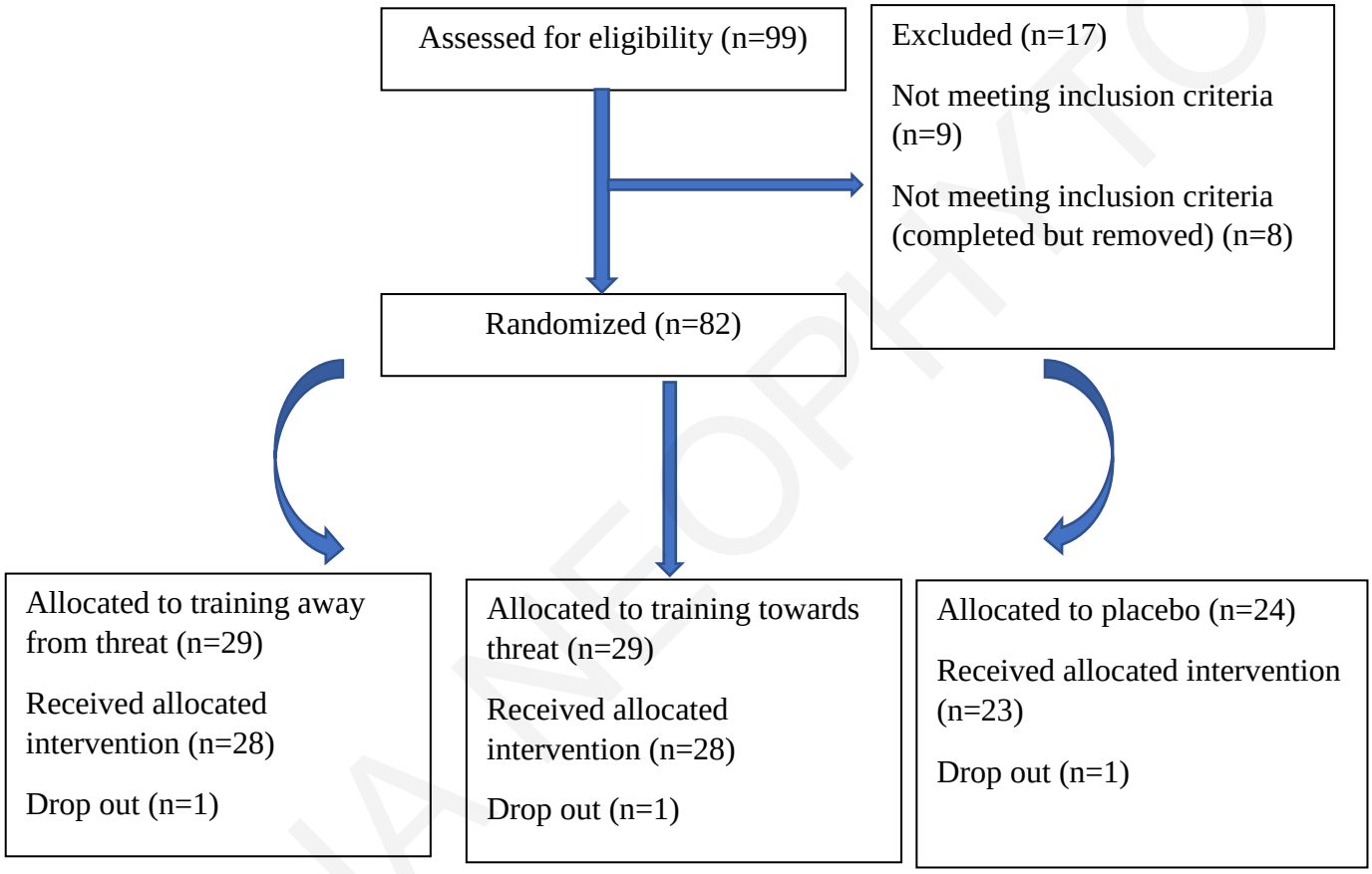

Figure 4: An Example of a Single Matrix of Disgusted and Neutral Faces

Figure 5: Corrugator changes from pre-treatment to post-treatment

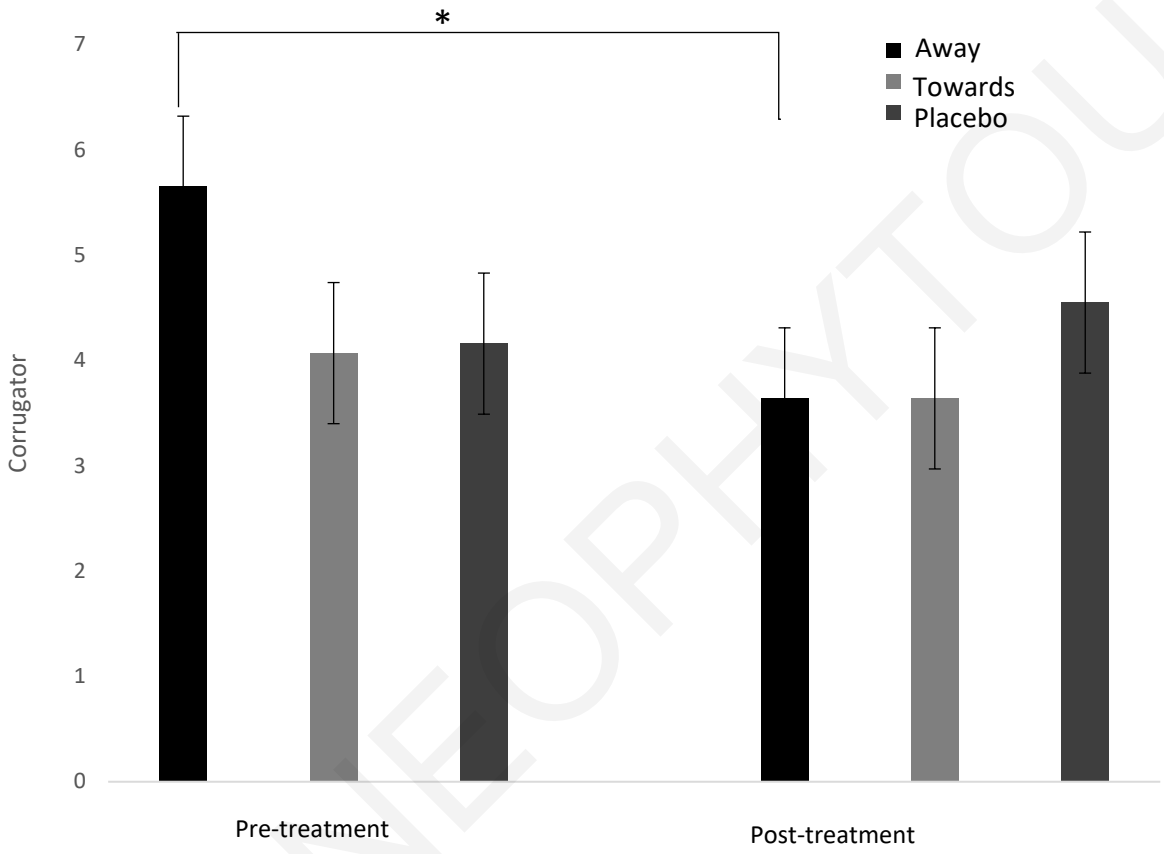

Figure 6: Corrugator changes from pre-treatment to post-treatment for PAB at training away from threat group

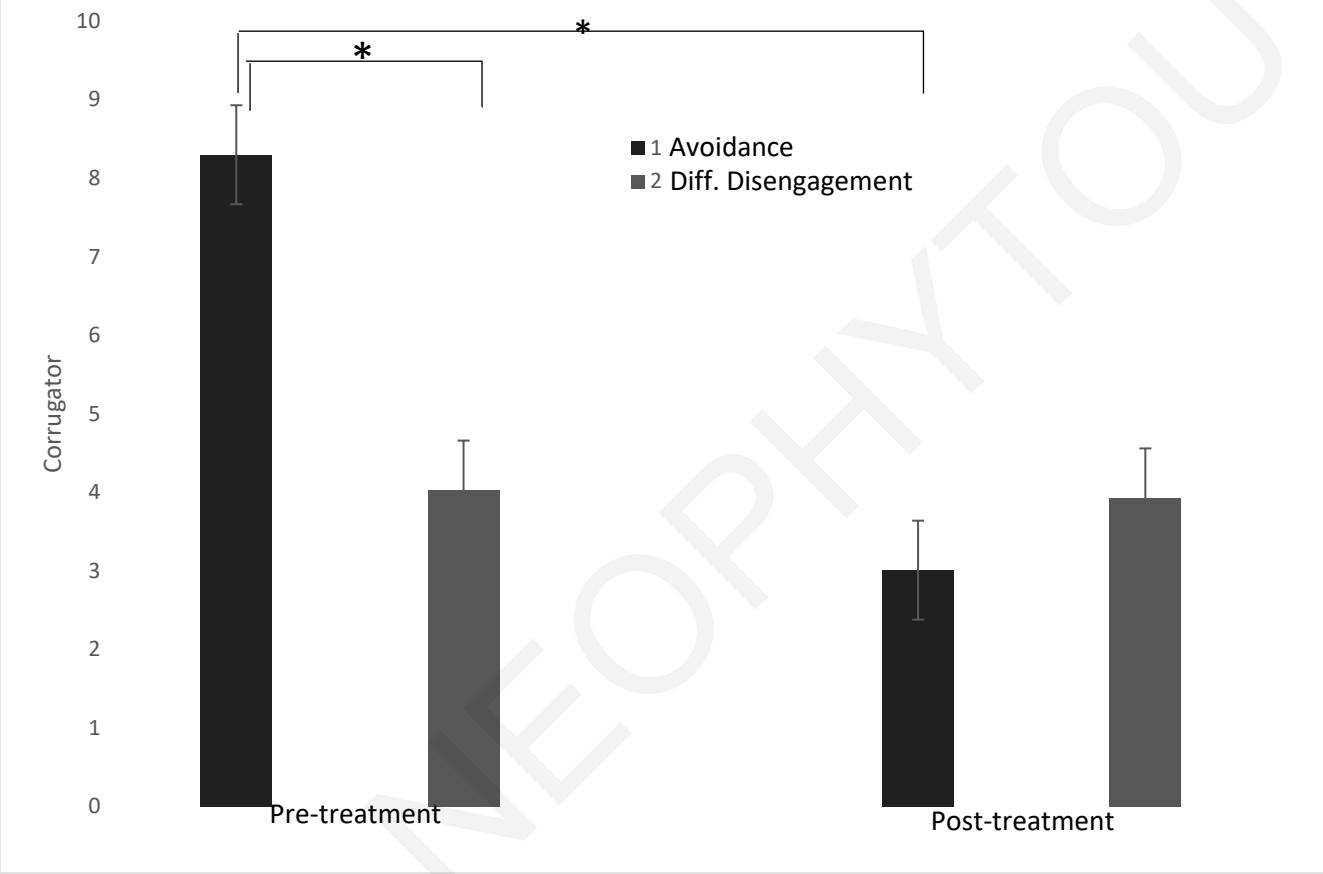

Figure 7: Simple slopes equations of the regression of private self-consciousness on AB levels at three levels of social anxiety