"I look there!" Attentional Bias in Individuals with High Trait Anxiety

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“Man is not worried by real problems
so much as by his imagined anxieties about real problems”

— Epictetus

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ABSTRACT

The association between high trait anxiety and attentional bias has been extensively explored (Bar-Haim et al., 2007; Van Bokstaele et al., 2014). The attentional bias is the propensity of individuals with high trait-anxiety to either direct attention towards threat-related stimuli or the difficulty to disengage attention from them (Beck and Clarke 1997; Eysenck 1992; Mathews 1990; Mathews and MacLeod 2002; Williams et al. 1988; Bar-Haim et al. 2007). However, it is not possible to find a unique definition of attentional bias. In particular, while some studies show facilitated attentional orienting towards stimuli evaluated as threatening, other experiments observe a difficulty in disengaging attention from the emotionally relevant stimulus. The finding of different mechanisms underlying the bias could be due to some methodological choices.

First of all, the choice of the experimental paradigm is particularly important. While the attentional bias evaluated through the Emotional Stroop Task provides information on the ability to resolve the conflict in response to a threatening stimulus, the Dot-Probe Task and the Emotional Spatial Cueing Task analyse the attentional orienting to emotionally relevant stimuli. Secondly, the selection of stimuli could also influence the results. In fact, according to the stimulus used (a word, a picture, or a face), the studies observe different results. Finally, another relevant factor concerns the evaluation of attentional bias in woman and men. Although anxiety is a predominantly female disorder (33.3% women; 22% men; McLean et al., 2011), few studies consider the gender.

To better understand the methodological issues in this field, this dissertation aimed to compare three different stimuli (words, pictures and faces) and four paradigms (Emotional Stroop Task, Dot-Probe Task, Emotional Spatial Cueing Task and Emotional-Target Spatial Cueing Task) in men and women characterised by high vs. low trait-anxiety. A few previous studies have considered the gender difference in the assessment of attentional bias in individuals with high vs. low trait-anxiety; the analysis of gender differences in the current thesis could represent an important factor in the evaluation of attentional bias. Specifically, males and females could adopt different pattern in response to threatening stimuli, i.e. avoidance of stimulus, rapid attentional

orienting toward the stimulus or difficulties in attentional disengagement from the stimulus.

In the first chapter, a systematic review of the literature has tried to more clearly define the inconsistencies between the results of studies on the attentional bias in individuals with high trait-anxiety. According to the results of this systematic review, four experiments were carried out. Each experiment used different paradigms and compared different types of stimuli (pictures, words, and faces). The second chapter presents the first experiment in which an Emotional Stroop Task was administered; in the third chapter, a Dot-Probe Task was used; in the fourth chapter, an Emotional Spatial Cueing procedure was employed (an emotional-relevance paradigm); finally, in the fifth chapter, an Emotional-Target Spatial Cueing procedure was adopted (emotional-irrelevance paradigm). In all the experiments both men and women participants were invited to participate, and the gender of participants was included as a between participants factor in the analyses.

CHAPTER 1

ATTENTIONAL BIAS IN HIGH TRAIT ANXIETY: EFFECTS OF EXPERIMENTAL PARADIGMS AND STIMULI

Abstract

Several cognitive theories suggest that the selective attentional system of individuals with high trait-anxiety is more sensitive to negative emotional stimuli. Specifically, many authors hypothesise an attentional bias toward threat-related stimuli. This systematic review analysed 30 studies assessing attentional bias in trait anxiety. The following inclusion criteria were used: 1) papers studying attentional bias toward threat-related stimuli in individuals with high trait-anxiety; 2) experiments using one of the following paradigms: Emotional Stroop Task, Dot-Probe Task, Emotional Spatial Cueing Task and Visual Search Task. This review aimed at examining whether attentional bias is due to attentional engagement or disengagement from threat-related stimuli, through the analysis of the results observed by different experimental paradigms and different types of stimuli. This review was carried out according to the PRISMA method. Thirty studies comparing attentional bias of individuals with high trait-anxiety to those with low trait anxiety were selected. The PubMed, PsycINFO and PsycARTICLES databases were employed. The results highlighted that the observed effects depend on the selection of the participants, the choice of the stimuli and the experimental paradigm. Some methodological suggestions are advanced to obtain more unambiguous results regarding the attentional bias in individuals with high trait-anxiety. Finally, the need to assess the psychometric properties of the experimental tasks used is recommended.

Keywords: Attentional bias; Trait anxiety; Emotional Stroop Task; Dot-Probe Task; Emotional Spatial Cueing Task; Visual Search Task

Introduction

Anxiety disorders, often associated with behavioural disorders (e.g., avoidance; American Psychiatric Association, APA, 2013), are characterised by a severe but unjustified fear evoked by situations and environmental or cognitive stimuli that do not justify such feelings. Fear is an emotion that occurs in response to a real or imaginary threat, and the high levels of arousal accompanying fear are adaptive to respond to possible danger. Anxiety, however, is the anticipation of a hypothetical future threat, and is often associated with muscle tension, behavioural avoidance and increased arousal (APA, 2013). In 2012, 7,3% of the worldwide population was affected by an anxiety disorder, i.e., one individual out of 14 (Baxter et al., 2012). Furthermore, it is estimated that 33.7% of the worldwide population has had an anxiety disorder at least once in their life (Bandelow and Michaelis, 2015).

Many authors have hypothesised that anxious people exhibit some biases in information processing (Beck and Clark, 1997; Mathews and Mackintosh, 2000; Foa et al., 1996; Mitte, 2008; Van Bokstaele et al., 2014). Four cognitive biases have been suggested: *interpretation bias*, *judgment bias*, *memory bias*, and *attentional bias*. The *interpretation bias* refers to the tendency of individuals with high compared to low trait-anxiety to interpret negatively ambiguous events and stimuli (Beck, 1976; Beck and Clark, 1997; Harvey et al., 1993; McNally and Foa, 1987; Mathews and Mackintosh, 2000). The *judgment bias* is the tendency to overestimate the costs or the probable occurrence of an adverse event (Lucock and Salkovskis, 1988; Foa et al., 1996). *Memory bias* consists of frequently remembering adverse events compared to neutral or positive events (Mogg et al., 1987; Williams et al., 1996; Mitte, 2008).

Since the 80s of the last century, the interest in the etiological role of attentional bias in anxiety disorders has been growing. Many theories and paradigms have been proposed to investigate this attentional process. The focus of this dissertation is the *attentional bias* in individuals with high trait-anxiety, i.e., the propensity of people with high trait-anxiety to focus the attention on threat-related stimuli (Beck and Clarke, 1997; Eysenck, 1992; Mathews, 1990; Mathews and MacLeod, 2002; Williams et al., 1988; Bar-Haim et al., 2007) or the difficulty to disengage attention from threat-related stimuli (Fox et al., 2001; Fox et al., 2002). Specifically, this paper focuses on nonclinical self-reported anxiety. High scores in self-reported trait anxiety could represent a vulnerability factor for the development and maintenance of anxiety disorders. Consequently, the study of the attentional bias in nonclinical anxiety could help the understanding of the development and exacerbation factors of anxiety disorders.

Theoretical background

Several theoretical approaches have described the attentional bias in individuals with high trait-anxiety, trying to define its etiology and the ways in which it manifests itself: the *Schema Theory* (Beck et al., 1985; Beck and Clarke, 1997), the *Preattentive level of the attentional bias* (Williams et al., 1988; Williams et al., 1997), the *General Negativity Hypothesis* (Williams et al., 1988), the *Emotion Drives Attention Hypothesis* (Öhman, 1993; Öhman, 1996; Öhman and Soares, 1993; Öhman and Soares, 1994), the *Attentional Control Theory* (Eysenck, 1992, 1997), the *Cognitive-Motivational Model* (Mogg and Bradley, 1998), the *Engagement and disengagement of attention* model (Fox et al., 2001; Fox et al., 2002) and the *Model of Theoretical Integration* (Bar-Haim et al., 2007).

Based on these theories, studies on anxiety have used different experimental paradigms to study the attentional bias. The most reliable theoretical models on attentional bias are summaries below.

The Schema Theory

The Schema Theory (Beck et al., 1985; Beck and Clarke, 1997) hypothesises that individuals with high trait anxiety present bias of interpretation of the stimuli present in their environment, which leads them to evaluate such stimuli as dangerous or threatening for their physical and psychological well-being. The interpretation bias would lead to overestimating the perception of danger, without any real environmental and contextual justification, which would cause pathological anxiety. According to the affective–cognitive–physiological-behavioural model (Beck and Clarke, 1997), the processing of the threat would occur quickly and automatically, and the resulting behaviour would serve an adaptive function for the individual, increasing his/her chances of survival. After the first phase of attentional orienting aimed to both locate and identify the threat, the person will refer to interconnected patterns of affective–cognitive-physiological-behavioural response, to guarantee her/his survival and safety. Subsequently, the individuals with high trait anxiety will resort to a second evaluation, which is also driven by schemas. This assessment would be slower and would require more significant resources. In this assessment, individuals with high trait-anxiety will assess whether their resources and coping strategies can cope with the threatening situation. According to this theoretical model, attentional bias may represent a causal factor of both exacerbation and maintenance of anxiety disorders. Attentional bias could lead people to frequently experience emotions of fear and anxiety in response to threat-related stimuli. This behaviour could lead them to interpret environmental information in a non-rational and realistic way.

The Preattentive level of the attentional bias

Williams and colleagues (Williams et al., 1988; Williams et al., 1997) have suggested that attentional bias toward threatening stimuli occurs at a pre-attentive level (automatic level) in individuals with high trait anxiety. This bias would be amplified when the anxious person is faced with highly stressful situations. Conversely, people with low trait anxiety would tend to direct their attention outside the threatening stimuli. A similar pattern occurs in the case of state anxiety; whereas individuals presenting high state of anxiety will direct their attention early and automatically toward the threat-related stimulus, low trait anxiety individuals will tend quickly to shift the focus of attention away from threatening stimuli, through the activation of slower and strategic processes, aimed at reducing anxiety. According to this theory, two systems are involved in the development of attentional bias: the *Affective Decision Mechanism* (ADM) and the *Resource Allocation Mechanism* (RAM). The ADM is responsible for the evaluation of threatening stimuli in the environment, and it is closely related to the state of anxiety that the individual feels at that time. The RAM is responsible for the allocation of attentional resources at that time. So in the presence of intense anxiety, the ADM will activate the RAM that will direct attention toward threat-related stimuli; conversely, if the trait anxiety is low, the RAM will not be activated. In this theoretical framework, attentional bias is identified as a vulnerability factor for the development of anxiety disorders.

The General Negativity Hypothesis

The General Negativity Hypothesis (Williams et al., 1988) predicts that the attentional bias is specific and directed towards a single category of stimuli that is emotionally relevant to one's pathology, such as anxiety disorders. Conversely, according to the

Emotionality Hypothesis (Martin et al., 1991; Mogg and Marden, 1990), the attentional bias would not aim at a single category of threatening stimuli, but at any information with significant emotional value.

The Emotion Drives Attention Hypothesis

Another cognitive model, which considers phobias explicitly, defines the attentional bias as the outcome of an automatic and early process (Öhman, 1993; Öhman, 1996; Öhman and Soares, 1993; Öhman and Soares, 1994). According to this model, the cognitive system would be sensitive to adverse stimuli (e.g., a spider or an angry face), which are processed automatically, and even without awareness. Accordingly, attention would be directed precociously and quickly toward stimuli evaluated as threatening.

The Attentional Control Theory

Eysenck (1992, 1997) has hypothesised that strong hypervigilance towards the surrounding environment is a specific trait of the anxious individual. Hypervigilance would result in both a constant scanning of the situation and a wider window of attention, which would allow easier detection of the threat. When a stimulus is assessed as threatening, the attentional focus will be reduced, and attention will be focused on that stimulus. The persistence of a hypervigilance state would lead anxious individuals, in comparison to non-anxious people, to evaluate the environment more dangerously and threateningly. For this reason, the anxious person would trigger a vicious circle that would contribute to exacerbation and maintenance of anxiety disorders.

The Cognitive-Motivational Model

Mogg and Bradley (1998) have proposed a cognitive-motivational model, which includes the *Threat Assessment System* and the *Goal Engagement System* (GES). The *Threat Assessment System* evaluates threatening stimuli, quickly and automatically. It will use the details and the information present in the environment and will be particularly sensitive in people with high trait anxiety. The second system will determine how the cognitive resources of the individual and the modalities of action will be allocated. If the threat is elevated, the anxious individual will interrupt the on-going activities to direct attention towards the stimulus. Conversely, if the stimulus is not rated as dangerous, the person will continue his/her actions, focusing on the positive stimuli in the environment.

Engagement and disengagement of attention

Fox and colleagues (Fox et al., 2001; Fox et al., 2002) have experimentally shown that attentional bias is not so much characterised by facilitation of attentional orienting towards the threatening stimulus, but it reflects a difficulty in disengaging attention from the threatening stimulus, once the latter has been identified. According to the authors, the difficulty of disengagement from a threatening stimulus would be indicated by slower RTs in response to threatening stimuli in the invalid trials compared to neutral trials. The facilitation of attentional engagement toward a threatening stimulus would be suggested by faster RTs to threatening stimuli on the valid trials compared to neutral trials.

A Model of Theoretical Integration

Bar-Haim and colleagues (2007) have proposed a model based on both the integration of various theories and the results obtained from their meta-analytical revision of the literature. According to the authors, the *Pre-attentive Threat Evaluation System* (PTES), designed to scan the surrounding environment, assess the danger of a stimulus. If the stimulus is evaluated as threatening, the *Resource Allocation System* (RAS) will increase the arousal level with consequent interruption of the on-going activities. Subsequently, the *Guided Threat Evaluation System* (GTES) will evaluate the context, comparing the current situation with previous conditions already experienced, and it will check whether coping resources are available. If the outcome of these evaluations leads to the assessment of the threat level as low, the GTES send feedback to the RAS to reduce the arousal. On the other hand, if the stimulus is evaluated as threatening, an intense level of arousal will be maintained, which lead to high anxiety. At this point, the *Goal Engagement System* (GES) will direct the attention wholly towards the threatening stimulus and will definitively interrupt the activities in progress, to better cope with the threat.

All these theories try to understand the mechanism underlying the attentional bias in individuals with high trait-anxiety. However, there are important limitations, as it is unclear the causal relation between attentional bias and anxiety (Van Bockstaele et al., 2014).

Many authors (for example, Bar-Haim et al., 2007; Mogg and Bradley, 1998) particularly emphasise the role of pre-attentive processes in the etiology of attentional bias. However, they do not clarify how the pre-attentive processes operate, either engaging attention and maintaining it on the threatening stimulus, which is the main focus of the theoretical model advanced by Fox and collaborators (Fox et al., 2001; Fox et, al. 2002). Although this later model does not give particular relevance to the pre-attentive processes, it provides a more accurate explanation of the processes behind the attentional bias, highlighting an attentional disengagement component. Adequate knowledge of the processes underlying the attentional bias is particularly relevant for the development of practical training aimed at counteracting the attentional bias in anxiety disorders. For this reason, the following review of the literature will try to frame all the experimental results according to the theoretical model proposed by Fox and colleagues, in particular by checking whether the attentional bias is the result of a facilitated attentional engagement or the outcome of difficulty in attentional disengagement from emotionally relevant stimuli.

Experimental paradigms

One of the central open questions in the attentional bias research concerns the nature of the bias itself. It is still unclear whether it reflects facilitation in the engagement of attention or difficulty in attentional disengagement from emotionally salient stimuli. It can not be excluded that both processes contribute to the attentional bias. One could hypothesise that a negative valence of a stimulus can quickly capture attention (facilitation in attentional engagement), but also that the negative stimulus catches attention longer, thus leading to difficulties in attentional disengagement. The measurement of these processes with the different paradigms used to measure the attentional bias seems crucial to solving this issue.

The experimental paradigms more commonly used to evaluate the attentional bias are the Emotional Stroop Task, the Visual Search Task, the Dot-Probe Task, and the Emotional Spatial Cueing Task.

The ***Emotional Stroop Task*** is a modified version of the classic Stroop task (Stroop, 1935). In the Stroop task, the subject is required to name the colour of the ink in which a word, indicating a colour, is printed. This task is a gold standard for measuring the resolution of a conflict (inhibition of automatic reading response) and for assessing cognitive flexibility. The inhibition of the response can be defined as an essential cognitive process, i.e., ignore the irrelevant information (Harnishfeger, 1995). Cognitive flexibility can be described as the personal ability to change strategies to both solve problems and shift the attentional focus according to the environmental demands (Krems, 1995). In the Emotional Stroop, the subject is required to name the colour of words that have emotional or neutral valence. If the person presents an attentional bias towards threatening stimuli, he/she will nominate the colours of the words with negative valence more slowly and less accurately than those of neutral valence words (MacLeod, 1991). This test can be administered using lexical stimuli (words with emotional value) or pictorial stimuli (e.g., faces). When the attentional bias is evaluated through the Emotional Stroop Task, facilitation in the engagement of attention should be indicated by faster RTs in response to threatening stimuli compared to neutral stimuli; the opposite condition should mean difficulty in the disengagement of attention (MacLeod 1991). The lack of independence between these two processes would seem to suggest that Emotional Stroop task is not quite appropriate to dissociate between attentional capture and attentional disengaging. However, in this systematic review, the evaluation of the studies that used the Emotional Stroop Task is crucial. Indeed, this task has been widely used in this field, and it is the only task leading to the assessment of attentional control.

The ***Visual Search Task*** (Öhman et al., 2001) requires participants to look for a target stimulus within a series of distractors. In participants with high trait anxiety, faster responses are observed when they search for a threatening target among neutral or positive distractors than the other way around. According to Öhman, faster RTs in response to a threatening stimulus within an array of neutral distractors would indicate a rapid capture of attention or a facilitated attentional engagement. Conversely, slower RTs to a neutral stimulus with a display of threatening distractors would mean difficulty in the disengagement of attention.

In the ***Dot-Probe paradigm***, proposed by MacLeod, Mathews and Tata (1986), two stimuli (one neutral and one threatening) are simultaneously presented and, subsequently, a probe stimulus is shown in the position of one of the two previously presented stimuli. The participant must detect as quickly as possible the probe by pressing a key. The stimuli can be words or images. In participants with high trait anxiety, faster RTs are observed in response to the probe presented in the same position of the threating stimulus compared to RTs in response to the probe shown in the area previously occupied by the neutral stimulus. When the Dot-Probe Task is used, facilitation in the engagement of attention should be indicated by faster RTs in response to the probe presented in the same position of the cue with a threating than neutral valence. The opposite pattern, i.e., more rapid responses to targets in the position of the neutral stimulus, should reveal a fast disengagement of attention from threatening information. Consequently, slower RTs in response to the probe presented in the same location of the neutral cue could suggest a difficulty in the disengagement from threatening cue (MacLeod et al., 1986). However, this experimental paradigm does not allow independently evaluating the rapid capture of attention (or facilitated attentional engagement) and the difficulty to disengagement of attention. However, the authors suggest that the difference between incongruent trails and congruent trails can be considered as an Attentional Bias index. A positive score indicates a rapid allocation of attention toward the threatening stimuli, while a negative score suggests attentional avoidance.

In the ***Emotional Spatial Cueing Paradigm*** (Fox et al., 2001), a spatial cue, consisting of a threatening or neutral stimulus, is presented in two possible locations on the screen. Then, on one of the two positions, a target stimulus is shown, to which the subject must respond by pressing a key. Attentional bias is present when the difference in RTs between valid trials (the target stimulus is presented in the cue position) and invalid (the target stimulus is presented in an uncued position) is higher for the trials with a threatening than a neutral cue. Using the Emotional Spatial Cueing Task, the attentional engagement should be indicated by faster RTs in valid trials with a threatening than a neutral valence. In contrast, a difficulty in attentional disengagement is revealed by slower RTs in invalid trials with a threatening than a neutral valence (Fox et al., 2001).

Aims of this systematic review

Although in the last 30 years attentional bias research has received a high interest in the international scene, many issues remain unresolved. The present systematic review of the literature aims at clarifying some inconsistent results and theoretical questions. The first is to evaluate whether the attentional bias towards threatening stimuli, characterising people with high trait anxiety, is due to an automatic and rapid allocation of attention towards the emotionally salient stimulus or a difficulty in the attentional disengagement from the emotionally salient stimulus. To disambiguate this issue, we will consider the experimental paradigms used to study attentional bias. In this regard, it may be useful to assess whether the various experimental paradigms are equivalent, or whether it is possible to identify an experimental task more sensitive to catch the attentional bias towards negative stimuli in people with high trait anxiety. Finally, we will attempt to evaluate the role played by the type of stimulus (lexical vs pictorial) in triggering the attentional bias.

Method

The systematic research was conducted using the PubMed, PsycINFO and PsycARTICLES databases. The keywords used were: attention* AND bias* AND anxi*. Articles were selected by using the following inclusion criteria:

1) Participants with age between 18 and 70 years;
2) People with high trait anxiety;
3) Articles published in peer review journals;
4) English language publications;
5) Experiments that have assessed the attentional bias through the following experimental paradigms: Emotional Stroop Task, Dot-Probe Task, Emotional Spatial Cueing Task and Visual Search Task;
6) Experiments that have assessed trait anxiety through standardised self-reports.

The following exclusion criteria have been used:

1) Studies that have considered other dimensions of anxiety (social anxiety, sensitivity to anxiety, etc.).
2) Studies that have examined State instead of Trait Anxiety, because different attentional biases are observed for Trait and State Anxiety (Pacheco-Unguetti et al., 2010).

Articles selection was made according to the Preferred Reporting Items from Systematic Reviews and Meta-Analysis (PRISMA; Moher et al., 2009). Articles published until March 2018 were considered. Of 2014 articles, 1957 were excluded following the removal of duplicates and screening for the title and abstract. The full texts of the remaining 57 articles were independently assessed by two judges (I.B. and M.C.). Of those articles, 27 were eliminated for not meeting the inclusion and exclusion criteria.

The agreement between raters was unanimous. Overall, 30 articles were selected, for a total of 52 experiments (see Figure 1).

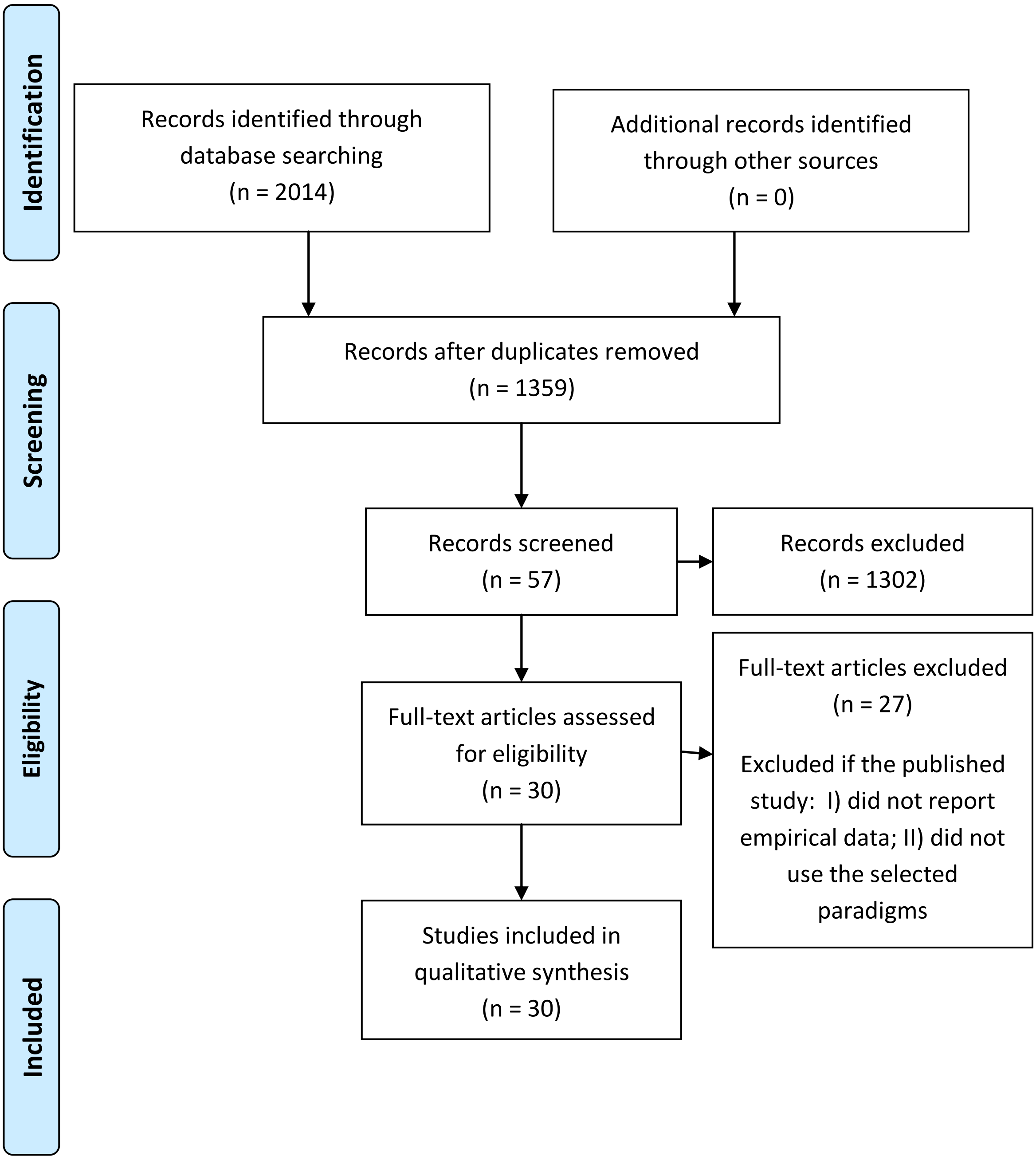


Figure 1. PRISMA flowchart of studies selection.

Results

A summary of the 30 selected papers is presented in Tables 1 to 4, organised by experimental paradigms. The results will be described by illustrating the differences in the RTs between groups and experimental conditions for each paradigm. If the authors did not specify the differences concerning RTs but reported the results exclusively regarding the attentional indices, the differences emerged in these indices will be reported. As it has already been described, for most of the experimental paradigms used to evaluate attentional bias (Emotional Stroop Task, Visual Search Task, Dot-Probe Task), we could assume that rapid RTs in response to a negative target or a negative cue indicate facilitation in the process of attentional engagement, while slower RTs indicate a difficulty in disengagement. Emotional Spatial Cueing is the only paradigm that allows explicitly dissociating between the process of engagement (only valid trials are involved) and disengagement (only invalid trials are involved).

Emotional Stroop Task

By using the Emotional Stroop Task, many studies (Dresler et al., 2009; Egloff and Hock, 2001) highlighted an association between Stroop interference and high trait anxiety, using words as stimuli. Renholdt-Dunne et al. (2009) administered the Stroop task by using both faces and words as targets. The authors observed slower RTs in response to threatening faces (especially for the emotion of anger) in the group of individuals with high trait-anxiety with low attentional control. This result was not replicated when the target was a word. Furthermore, an attentional bias was found towards both threatening words (Dresler et al., 2009, Egloff and Hock, 2001) and faces (Renholdt-Dunne et al., 2009). Attentional bias was also observed in another study using the Emotional Stroop task with a masking paradigm (Van den Hout et al., 1995). In this experiment, threatening or neutral words were presented for 30 ms, after which random letters were superimposed on the target words. The task of the subject was to identify the colour of the words. Although that perception was hindered by the masking procedure, the results showed slower RTs in response to threatening than neutral stimuli. This attentional bias might be better explained by facilitated engagement.

Finally, an attentional bias towards threatening words has not been confirmed in another study (Renholdt-Dunne et al., 2009).

In conclusion, four experiments out of six show difficulties in disengaging attention from a negative irrelevant dimension (two using words and two faces as stimuli), an experiment highlights facilitated engagement, and one does not show a difference between negative and neutral stimuli.

These inconsistent results may be due to the choice of the emotional valence of the words used: while Dresler and colleagues (2009) used only negative words (e.g., victim), Egloff and Hock (2001) used threat-related words concerning the physical background (e.g., death) or concerning the self (i.e., failure), and Reinholdt-Dunne et al. (2009) have also included threatening words with a social background (e.g., failure), even if the authors did not evaluate social anxiety. Another difference that could explain the discrepancy between the results of these experiments lies in the participants' selection. Egloff and Hock (2001) and Dresler and colleagues (2009) included only people obtaining extreme scores in the STAI (Spielberger et al., 1983), while Reinholdt-Dunne et al. (2009) used two inclusion criteria: extreme scores at both STAI (Spielberger et al., 1983) and Attention Control Scale (ACS, Derryberry and Reed, 2002).

Table 1 shows the studies that analysed the attentional bias in trait anxiety by using the Emotional Stroop Task.

Table 1. Summary of the studies that analysed the attentional bias in trait anxiety using the Emotional Stroop Task. In the table, Engagement Facilitation is defined by faster reaction times in response to threatening stimuli compared to neutral stimuli, while Disengagement Difficulty is characterised by slower reaction times in response to threatening stimuli compared to neutral stimuli. Both engagement and disengagement indicate an attentional bias.

Authors	*Year*	*Stimuli*	*Stimulus Duration (in ms)*	*N*	*Results*	*Engagement Facilitation*	*Disengagement Difficulty*	*No attentional Bias*
Brosschot et al.	1999	Words	3000	51	Slower RTs in response to physical threat stimuli (657 ms) than social positive stimuli (627 ms) and social threat stimuli (639 ms) in HA		X	
Van den Hout et al.	1995	Words	30*	34	Faster RTs in response to threatening (690 ms) than neutral (705 ms) stimuli in HA**, compared to LA participants	X		
Dresler et al.	2009	Words	-	50	Positive correlation between Stroop interference and anxiety score		X	
Egloff and Hock	2001	Words***	-	121	Positive correlation between Stroop interference (70.43 ms) and anxiety score		X	
Reinholdt-Dunne et al.	2009	Faces	2000	56	Higher Stroop interference in response to emotional faces in HA (9 ms) than LA (-3 ms)		X	

Reinholdt-Dunne et al.	2009	Words	2000	56	No group differences	X

HA: High Trait Anxiety; LA: Low Trait Anxiety
* Subliminal condition
**ms inferred from Figures
*** Pencil and paper version

Visual Search Task

By administering the Visual Search Task to people with high trait anxiety, Fox et al. (2000) observed a higher number of errors and slower RTs when the distractors were angry faces rather than happy or neutral faces. Furthermore, faster RTs and fewer errors were detected when the target was threatening, and the distractors had a neutral or happy emotional valence. In a second experiment, the duration of the target was experimentally manipulated, from 300 ms to 800 ms. In this experiment, the authors found that participants with high trait-anxiety presented faster RTs when the target was an angry face, rather than a happy face, and the distractors were neutral. Another study (Masumoto, 2010) found no difference between threatening and neutral stimuli in people with high trait anxiety.

In conclusion, in individuals with high trait-anxiety two experiments have observed faster RTs to threatening targets (i.e., an attentional engagement towards threatening stimuli) (Fox et al., 2000; Matsumoto, 2010), whereas another experiment found slower RT to threatening targets (i.e., an attentional disengagement from threatening stimuli) (Fox et al., 2000). Finally, Derakshan and Koster (2010) did not observe any attentional bias. All these experiments have employed faces as cues, but the discrepancy of these results can be explained by the selection of the stimuli. While Fox and colleagues (2000) and Matsumoto (2010) used schematic faces, Derakshan and Koster (2010) used real faces and specific software to modify facial expressions. Although the software changes the facial expressions of emotion explicitly, the ecological validity of the resulting stimulus is questionable. The images built by such software cannot be compared to photographs of professional actors or pictures selected from a validated database. Furthermore, this software could have produced false emotional expressions, such as to be less valid than a schematic face, which symbolically expresses an emotion clearly. In conclusion, two experiments out of four show facilitation in attentional engagement (i.e., faster RTs to threatening stimuli), an experiment highlights a difficulty in attentional disengagement (i.e., slower RTs to threatening stimuli), and one does not confirm a difference between threatening and neutral stimuli.

Table 2 shows the studies that analysed the attentional bias in trait anxiety using Visual Search Task.

Table 2. Summary of the studies that analysed the attentional bias in trait anxiety using the Visual Search Task. In the table, Engagement Facilitation is defined by faster reaction times in response to threatening stimuli compared to neutral stimuli, while Disengagement Difficulty is characterised by slower reaction times in response to threatening stimuli compared to neutral stimuli. Both engagement & disengagement indicate an attentional bias.

Authors	*Year*	*Stimuli*	*Target Duration (in ms)*	*N*	*Results*	*Engagement Facilitation*	*Disengagement Difficulty*	*No attentional Bias*
Derakshan & Koster	2010	Faces	5000	77	No groups differences			X
Fox et al. (Exp. 1)	2000	Faces	2000	38	Slower RTs in response to happy face in a angry crowd (950 ms) in HA than in LA participants**		X	
Fox et al. (Exp. 2)	2000	Faces	2000	30	Faster RTs in response to angry faces in a neutral crowd (810 ms) than happy faces in a neutral crowd (885 ms) in HA** than in LA participants	X		
Matsumoto	2010	Faces	4000	42	Faster RTs in response to angry faces in a neutral crowd in HA (1750 ms)** than in LA participants	X		

HA: High Trait Anxiety; LA: Low Trait Anxiety

** ms inferred from Figure.

Dot-Probe Task

By using the Dot-Probe Task, many authors (Mogg and Bradley, 1999; Bradley et al., 2000; Fox 2002) observed in individuals with high trait-anxiety faster RTs in response to the probe presented in the same position of the face cue with a threating than a neutral valence. By using words as cue, some authors (MacLeod and Mathews, 1988; Yiend and Mathews, 2001) confirmed in people with high trait-anxiety faster RTs in response to the probe shown in the same position of the word with a threating than a neutral valence (i.e., a higher bias score, or attentional bias index). Other authors (Brosschot et al., 1999; Keogh et al., 2001) observed in individuals with high trait-anxiety faster RTs in response to the probe presented in the same position of a word conveying a physical threating than a social threating (i.e., a higher bias scores) (Keogh et al., 2001) or positive valence (Brosschot et al., 1999). Finally, Salemink et al. (2007) found a higher disengaging index (the disengaging index was computed by subtracting the RTs to the probe that appears in the same position of the neutral cue from the RTs to the probe that appears in the same position of the threatening cue) in individuals with high trait-anxiety than in people with low trait anxiety. By using pictures, Koster et al. (2006) found faster RTs in incongruent (the probe is presented in the same location of the cue with threatening valence) than congruent (the probe is presented in the same location of the cue with neutral valence) trials in individuals with high trait anxiety. Finally, people with high trait anxiety, compared with persons with low trait anxiety, showed a higher bias score when the duration of the cues was brief (100 ms and 500 ms), and a lower bias score when the duration of the cues was longer (1250 ms; Koster et al., 2005).

In summary, results of 13 experiments show faster RTs in response to the probe presented in the same position of the cue with a threating than neutral valence (i.e., facilitation in the attentional engagement). Seven studies did not found any difference between threatening and neutral stimuli, while three experiments revealed slower RTs in response to the probe shown in the same position of the cue with a threating than neutral valence (i.e., difficulty in attentional disengagement). Specifically, faster RTs in response to the probe presented in the same position of the cue with a threating than neutral valence (i.e., facilitation in attentional engagement) was found when faces (Mogg and Bradley, 1999; Bradley et al., 2000; Fox, 2002) or words (MacLeod and

Mathews, 1988; Yiend and Mathews, 2001; Keogh et al., 2001; Brosschot et al., 1999) were used as cues. Facilitation in the engagement of attention was also observed by considering different cue durations: 100 ms (Koster et al., 2005), 500 ms (Bradley et al., 1998; Koster et al., 2005) and 1250 ms (Koster et al., 2005). Slower RTs in response to the probe presented in the same position of the neutral cue (i.e., a difficulty in the disengagement of attention) was observed by using pictures as cues (Koster et al., 2004; Koster et al., 2006) and a higher disengaging index was found by using words as cues (Salemink et al., 2007).

Interesting results have been observed by employing faces, words, and pictures as stimuli and by using a masking paradigm. Lee and Knight (2009) have used a Dot Probe task with young adults and elderly, both characterised by high or low anxiety. In half of the trials the duration of the double cue was brief (20 ms for the young adults and 50 ms for the elderly), in the other half of the trials, the double cue had a duration of 1500 ms for both groups. When the duration of the cue was brief, a masking paradigm was also employed, with a random string of letters superimposed to the cue when the stimuli were words, and fragments of images randomly linked when the stimuli were faces or pictures. The results showed an attentional bias (i.e., faster RTs in response to the probe presented in the same position of the cue with a threating than neutral valence only in elderly with high trait anxiety when the cue was a word, and a masking paradigm was used. No effects were observed in the elderly when the images were used as cues. In the group of young adults, no significant differences were found. Furthermore, no effects were reported when the double cue duration was longer (1500 ms).

Some inconsistent results concerning the attentional bias could depend on the selection of the stimuli. Bradley et al. (2000) used stimuli with negative, positive and neutral emotional valence, while MacLeod and Mathews (1988) selected only threating and neutral stimuli. Furthermore, Bradley et al. (2000) utilised faces, while MacLeod and Mathews (1988) employed words as a cue. Therefore, the different results could be due to the higher relevance of faces compared to words. Koster and colleagues (Koster et al., 2004; Koster et al., 2006) used images selected from a validated database, namely the International Affective Picture System (IAPS; Lang et al., 1999), finding difficulty in attentional engagement.

Conversely, Wilson and MacLeod (2003) did not find an attentional bias by using a Dot-Probe Task and by selecting as cues pictures selected from a not standardised database provided by the University of Western Australia Cognition and Emotion Laboratory. Therefore, this null finding could be due to this methodological limit, i.e., the selection of faces from a pool of 300 non-standardized stimuli. The only study (Lee and Knight, 2009) that compared different stimuli (words, faces, and pictures) as a cue found faster RTs in response to the probe presented in the same position of the words with a threating than neutral valence (i.e., facilitation in the attentional engagement) only in a masked condition. This result seems to suggest that the unawareness of the threatening stimulus can play a role in the attentional bias, i.e., the conscious perception of the threat could put into play cognitive defence mechanisms. However, it is important to underline that the participants are elderly subjects, while the other studies have considered university students.

In conclusion, thirteen experiments out of twenty-three observed facilitation in attentional engagement (four using words, six faces and four pictures as stimuli), three experiments found a difficulty in attentional disengagement (two using pictures and one using words as stimuli), and seven found no differences between negative and neutral stimuli (three using faces, one using words and two using pictures as stimuli). Table 3 shows the studies that analysed the attentional bias in trait anxiety using Dot-Probe Task.

Table 3. Summary of the studies that analysed the attentional bias in trait anxiety using the Dot-Probe Task. In the table, Engagement Facilitation is defined by faster reaction times in response to threatening stimuli compared to neutral stimuli, while Disengagement Difficulty is characterised by slower reaction times in response to threatening stimuli compared to neutral stimuli. Both engagement & disengagement indicate an attentional bias.

Authors	*Year*	*Stimuli*	*Cue Duration (in ms)*	*N*	*Results*	*Engagement Facilitation*	*Disengagement Difficulty*	*No Attentional Bias*
Mogg & Bradley	1999	Faces	500	40	Higher bias index score in response to threatening stimuli in HA (8 ms) than LA participants (-1 ms)	X		
MacLeod & Mathews	1988	Words	500	36	Faster RTs to detect probes in the same area as threatening stimuli (458.5 ms) in HA than LA participants	X		
Bradley et al.	2000	Faces	500	55	Higher bias index score in response to threatening stimuli in HA (4.4 ms) than LA than LA participants (-5.3 ms)	X		
Yiend & Mathews (Exp. 1)	2001	Words	500	40	Faster RTs to detect probes in the same area as threatening stimuli (519 ms) than neutral stimuli (530 ms) in HA than LA participants	X		
Keogh et al.	2001	Words	500	51	Higher scores in bias index in response to social threatening stimuli (8 ms) than physical threatening stimuli (-1 ms) in HA than LA participants **	X		

Wilson & MacLeod	2003	Faces	500	40	No group differences			X
Koster et al.	2004	Pictures	500	42	Slower RTs in response to incongruent (442 ms) trials than congruent trials (424 ms)		X	
Koster, Combez et al.	2006	Pictures	500	42	Higher bias index scores in response to threatening stimuli in HA (18 ms) than LA (-1 ms)		X	
Salmenik et al.	2007	Words	500ms	40	Higher disengagement score in HA (10.02 ms) than LA participants (-2.54 ms)		X	
Lee & Knight	2009	Faces	30/60*	148	-			X
Lee & Knight	2009	Words	30/60*	148	Lower bias index in the subliminal condition (-30 ms) than in the supraliminal condition (38 ms) in HA** than LA elderly participants	X		
Lee & Knight	2009	Pictures	30/60*	148	-			X
Lee & Knight	2009	Faces	1500	148	-			X
Lee & Knight	2009	Words	1500	148	-			X
Lee & Knight	2009	Pictures	1500	148	-			X
Fox (Exp. 1)	2002	Faces	500	32	Higher bias index score in response to threatening stimuli (23.7 ms), than positive stimuli (-28.56 ms) in HA Lower bias index	X		

					score in the subliminal condition (-30 ms) than in the supraliminal condition (38 ms) in HA** than LA participants			
Fox (Exp. 2)	2002	Faces	2000	36	Higher bias index score in response to threatening stimuli in HA (40.4 ms) than LA (-5.7 ms) participants in the left visual field;	X		
					Higher bias index score in response to threatening stimuli in HA (15.8 ms) than LA participants (1.4 ms) in right visual field			
Brosschot et al.	1999	Words	500	51	Higher scores in bias index in response to social threatening stimuli (31 ms) than physical threatening stimuli (-30 ms) and social positive stimuli (-50 ms) in HA than LA participants	X		
Bradley et al.	1998	Faces	500	38	Higher bias index in response to threatening stimuli (16 ms) than positive stimuli (-15 ms) in HA than LA participants	X		
Bradley et al.	1998	Faces	1250	38	No difference between groups			X
Koster et al.	2005	Pictures	100	43	Higher scores in bias index in response to threatening stimuli in HA (12 ms) than LA (0 ms) participants	X		

Koster et al.	2005	Pictures	500	43	Higher scores in bias index in response to mild threatening stimuli in HA (14 ms) than LA (-12 ms) participants	X
Koster et al.	2005	Pictures	1250	43	Higher scores in bias index in response to mild threatening stimuli in LA (-21 ms) than HA participants (-3 ms)	X

HA: High Trait Anxiety; LA: Low Trait Anxiety

* Subliminal condition

** ms inferred from Figure

Emotional Spatial Cueing

Many experiments have found an attentional bias towards threat-related stimuli in anxious individuals by using the Emotional Spatial Cueing task (Fox et al., 2002; Massar et al., 2011; Sagliano et al., 2014; Azarian et al., 2016; Broomfield and Turpin, 2005; Yiend and Mathews, 2001). Specifically, many authors have observed difficulty in the disengagement from threatening stimuli (i.e., disengagement is revealed by slower RTs to the threatening than neutral valence cue in the invalid trials) (Koster et al., 2006; Mogg et al., 2008; Sagliano et al., 2014; Yiend and Mathews, 2001; Fox et al., 2002). Fox, Russo, and Dutton (2002) showed a higher cue validity effect (i.e., slower RTs in invalid than valid trials) when the cues were angry faces than neutral faces in high trait anxiety individuals, whereas similar validity effects were found for angry and neutral faces in the group with low trait anxiety. Further analyses showed that in people with high trait anxiety the effect of validity was higher for negative than neutral or happy faces and the authors interpreted this result as difficulty in attentional disengagement. Similar effects were observed by Mogg, Holmes, Garner and Bradley (2008), who used both a central and a peripheral cueing paradigm, employing faces as cues stimuli. The central cue was not related to the target position and thus was used as a control condition for computing the difference between the RTs obtained in neutral and threatening cues. The results showed that the participants with high trait anxiety responded faster when the cue has a threatening rather than a neutral valence in the valid trials, while participants with low trait anxiety showed no difference. Furthermore, an attentional bias score on the peripheral cueing task was calculated by using the following formula: (mean RT from invalid threat trials - mean RT from valid threat trials) - (mean RT from invalid neutral trials - mean RT from valid neutral trials). Participants with high anxiety levels compared to those with low anxiety levels presented a higher attentional bias score (higher validity effect of negative than neutral cues). However, when the central cue block was used as a control condition, no group differences are observed in the invalid trials.

Other studies (Koster et al., 2006; Massar et al., 2011; Sagliano et al., 2014; Azarian et al., 2016) observed faster RTs in valid trials when the cue was a threatening than a neutral stimulus (i.e., facilitation of attentional engagement towards threatening stimuli) in people with high trait anxiety. Broomfield and Turpin (2005) used words as cues. In the first experiment (cue duration: 100 ms) the authors observed inhibition of return (Posner and Cohen, 1984), with faster RTs in the invalid, rather than in valid trials. Participants did not show attentional facilitation (i.e., faster RTs) to emotional stimuli. In a second experiment, the authors changed the duration of the cue (500 ms). The results now showed slower RTs in the invalid trials when the cue was a threatening word only in individuals with high trait anxiety. The fact that anxious individuals show a slower response in invalid trials with a threatening stimulus could indicate a difficulty in the disengagement of attention from the threatening stimulus that would result in a delay in shifting attention from the threatening cue to the target.

The inconsistent results observed in the studies using the Emotional Spatial Cueing could be due to some methodological differences. The effects observed by Massar et al. (2011) and Azarian et al. (2016) are different from those found by the Fox et al. (2002) and Mogg et al. (2008). Indeed, Fox et al. (2002) and Mogg et al. (2008), to evaluate the three components of attention (shift, engagement and disengagement), have used an emotional Spatial Cueing paradigm, with a peripheral predictive cue, while Azarian and colleagues (2016) used a central non-predictive cue. However, the cue used by these authors had a social value, since it was a human figure. Therefore it could have also involved an automatic component of attention (Friesen and Kingstone, 1998). This difference could have led to conflicting results. In the Massar et al. (2011) study a sound was presented at the end of each trial with emotional value, and it was predicted by the cue.

Furthermore, it is interesting to note the different results observed in the first and the second experiment of Massar et al.'s study (2011). In the first experiment, the participants were divided in high and low trait anxiety, depending on the scores obtained a posteriori on the STAI (Spielberger et al., 1983), by contrast in the second experiment the participants were previously selected according to the extreme scores obtained in the STAI. Although only the people with high trait anxiety presented an attentional engagement towards threatening stimuli, according to the results of Azarian et al. (2016), all participants presented a difficulty in the disengagement of attention from the emotionally relevant stimulus. It could be hypothesised that the auditory reinforcement, especially with a threatening valence, could have led to an increase in the activation in people with low anxiety. Other differences are the type of stimuli used:

both Fox et al. (2002) and Mogg and colleagues (2008) used faces as cues. In contrast, Broomfield and Turpin (2005) used words. Azarian and colleagues (2016) used whole human figures, modifying only the facial expressions. Furthermore, Massar and colleagues (2011) do not report the criterion according to which the stimuli were selected.

It can be suggested that to obtain a higher ecological validity, it would be more advantageous to use images and not words. Moreover, it would be desirable to select pictures from a validated database (for example, Mogg and colleagues have used the NimStim Set of Facial Expressions). Finally, the inconsistent results observed in the studies that manipulated the duration of the cue (Koster et al., 2006; Sagliano et al., 2014) could also be due to the type of stimuli used. Koster and colleagues (2006) selected pictures from the IAPS (Lang et al., 1999) while Sagliano and collaborators (2014) have used images that have no validated emotional value. It could be hypothesised that the negatives finding observed when the cue duration was 200 ms and 500 ms in the experiment of Sagliano et al. (2014) may be due to this methodological limitation, i.e., the type of stimuli used.

In conclusion, eight experiments out of nineteen show facilitation in attentional engagement (one using words, two faces and four pictures as a cue). Six experiments found a difficulty in attentional disengagement (four using faces and two using pictures as a cue), while five did not highlight a difference between negative and neutral stimuli (three using pictures, one using words and one using faces as cues).

Table 4 shows the studies that analysed the attentional bias in trait anxiety using Emotional Spatial Cueing Task.

Table 4. Summary of the studies that analysed the attentional bias in trait anxiety using the Emotional Spatial Cueing. In the table, Engagement Facilitation is defined by faster RTs in valid trials with a threatening than a neutral valence, while Disengagement Difficulty is characterised is revealed by slower RTs in invalid trials with a threatening than a neutral valence. Both engagement and disengagement indicate an attentional bias.

Authors	*Year*	*Stimuli*	*Cue Duration (in ms)*	*N*	*Results*	*Engagement Facilitation*	*Disengagement Difficulty*	*No attentional Bias*
Yiend & Mathews (Exp. 2)	2001	Pictures	500	39	Slower RTs in response to high threatening picture (483 ms), than mild threatening (464 ms) picture in HA than in LA participants		X	
Yiend & Mathews (Exp. 3)	2001	Pictures	500	40	No group differences			X
Fox, Russo & Dutton (Exp. 1)	2002	Faces	250	34	Higher cue validity index in response to angry faces (66 ms) than neutral faces (49 ms) in HA than in LA participants		X	
Fox, Russo & Dutton (Exp. 2)	2002	Faces	300	48	IOR effect for happy (-19 ms) and neutral (-14 ms) stimuli, not for angry faces (-2 ms)		X	
Fox, Russo & Dutton (Exp. 3)	2002	Faces	300	80	Higher IOR effect for angry faces (3.3 ms) than neutral faces (-19 ms) in HA than in LA participants		X	
Broomfield &	2005	Words	100	60	No group differences			X

Turpin (Exp. 1)							
Broomfield & Turpin (Exp. 2)	2005	Words	500	60	Faster RTs in response to threatening invalid trials (336 ms) than neutral invalid trials (366 ms) in HA than in LA participants	X	
Mogg et al.	2008	Faces	200	43	Higher “slowing effect” in response to threatening cues in HA (9 ms) than LA (2 ms) participants in central cue task		X
Mogg et al.	2008	Faces	200	43	Faster RTs in response valid threat cues (405 ms) than valid neutral cues (419 ms) in HA than in LA participants	X	
Massar et al. (Exp.1)	2011	Faces	200	52	Positive correlation between anxiety and engagement score	X	
Massar et al. (Exp.2)	2011	Faces	200	44	Higher validity effects on threat trials (51.9 ms) than neutral trials (11.6 ms) in HA than in LA participants	X	
Sagliano et al.	2014	Pictures	100	95	Higher disengagement score in HA (13 ms) than LA (2 ms) participants		X
Sagliano et al.	2014	Pictures	200	95	Higher engagement score in HA (1.88 ms) than LA (-8.84 ms) participants	X	
Azarian et al.	2016	Faces	200	26	Faster RTs congruent emotional trials than incongruent trials in HA than in LA	X	

					participants		
Azarian et al.	2016	Faces	500	26	No group differences		X
Koster et al. (Exp.1)	2006	Pictures	100	47	Higher cue validity index in HA (31 ms) than LA (14 ms) participants	X	
Koster et al. (Exp.1)	2006	Pictures	500	47	Higher cue validity index in HA (15 ms) than LA (-5 ms) participant	X	
Koster et al. (Exp.2)	2006	Pictures	200	37	No group differences		X
Koster et al. (Exp.2)	2006	Pictures	500	37	No group differences		X

HA: High Trait Anxiety; LA: Low Trait Anxiety

Discussion

The study of attentional bias in individuals with high trait-anxiety seems relevant because it may allow us to understand some mechanisms that contribute to the determination and maintenance of anxiety disorder. Indeed, anxiety could be seen as a continuum (Endler and Kocovski, 2001). In one extreme there is low trait anxiety, and in the other extreme, there is high trait anxiety. A severe level of trait anxiety may have significant clinical consequences, being assimilated to anxiety disorders. Therefore, it would be desirable to assess the attentional bias even in clinical population with a generalized anxiety disorder, although some authors (Yend et al., 2014) have found that people with a Generalized Anxiety Disorder showed a pattern more similar to control, whereas the sub-clinical sample (i.e., participants with high scores in Anxiety Trait) showed a disengaging deficit.

This field of research is relatively recent, and in the published studies there are numerous methodological differences. These differences also lead to various definitions of attentional bias. The objectives of this systematic review of the literature were to try to clarify some methodological inconsistencies, to determine a more adequate and articulated profile of attentional bias in people with high trait anxiety. The results of the review will be discussed according to some relevant methodological questions on the attentional bias.

The role of stimulus type in inducing attentional bias: attentional engagement vs. attentional disengagement

The results seem to confirm a strong relationship between trait anxiety and attentional bias toward threatening or negative stimuli. In fact, among the 52 experiments analysed, 24 observed an attentional bias that manifested itself as facilitation of attentional engagement (i.e., faster RTs to negative stimuli), 14 found difficulty in disengagement (i.e., slower RTs to negative stimuli) and fourteen did not confirm the presence of attentional bias.

This inconsistency in the results would seem partial due to the nature of the stimuli used. Attentional bias was not found when the images were selected from a not validated database (for example, Wilson and MacLeod, 2003), or were created by ad hoc software (for example, Derakshan and Koster, 2010).

Generally, facilitation toward threatening stimuli has been observed when lexical stimuli have been used (e.g., Keogh et al., 2001) and difficulty of attentional disengagement from threatening stimuli was found when pictorial stimuli had been used (e.g., Mogg et al., 2008). These different results could be explained by hypothesizing that reading, being an automatic process, may involve a faster attentional capture, followed by a rapid response that could allow a higher attentional engagement to the lexical stimulus. Conversely, a pictorial stimulus, as perceptively and emotionally more salient, could need of a further complex and time-consuming information processing and so it can lead to a higher difficulty in attentional disengagement.

Another important issue that emerged from this analysis is the role of the sampling. While evidence of attentional bias was more readily observed if participants were recruited through the selection of extreme scores at the STAI, this was not the case if participants were selected through the various inclusions criteria (for example, Reinholdt-Dunne et al., 2009) or questionnaires different from the STAI (for example, Bradley et al., 1998).

One aim of the present review was to try to understand the nature of the attentional bias itself, that is, whether either rapid attentional engagement or slow attentional disengagement (or both) underlie the observed attentional bias. Most experiments confirm rapid attentional engagement rather than slow disengagement (31 out of 43 experiments). Despite this, it is not easy to disambiguate this issue. One of the factors that do not allow clarifying the nature of the attentional bias lies in the specific characteristics of the experimental paradigms used to evaluate it. Three of the four experimental paradigms (Emotional Stroop, Visual Search and Dot-Probe) used to assess the attentional bias do not allow evaluating engagement and disengagement independently. Nevertheless, it is crucial the study of all the paradigms used in this field. Using the Dot-Probe Task, when faster reaction times (RTs) to target preceded by a negative cue are detected these are interpreted as an index of a rapid attentional engagement, while when slower RTs to target preceded by negative cue are observed, the author explained this result like difficulty in attentional disengagement. Using the Emotional Stroop Task, faster RTs in response to threatening target have been considered as rapid attentional engagement, while slower RTs in response to threatening target could be seen as a difficulty of disengagement. In the Visual Search Task, faster

RTs in response to negative target have been considered as facilitation of attentional engagement, while slower RTs in reply to neutral target in a display of threatening distractors was interpreted as a difficulty of attentional disengagement. By considering these paradigms, 16 experiments confirm a rapid attentional engagement and eight a slower disengagement. In the case of early engagement, one could speculate that the negative stimulus catches attention quickly, but also that attention is diverted from negative stimulus just rapidly as, i.e. the anxious person tries to faster respond with the aim to avoid the negative stimulus promptly.

On the other hand, a slow attentional disengagement from the negative stimulus can be interpreted as difficulty in diverting attention from the negative stimulus. Put in these terms, one could assume that it is above all a slow disengagement to reinforce a negative vision of the world in individuals with high trait-anxiety. However, the faster engagement of attention to negative stimuli can also contribute to depict a negative view of the world for individuals with high trait-anxiety. Unlike these paradigms, Emotional Spatial cueing allows evaluating both engagement and attentional disengagement. In this case, approximately the same number of experiments highlights rapid engagement and slow disengagement (8 experiments vs. 6 experiments).

The role of the experimental paradigms in the detection of the attentional bias

Despite the numerous studies conducted on the attentional bias, it remains unclear whether there is an experimental task that can better discriminate this phenomenon. The paradigms analysed in this review are of a different nature; therefore it is not surprising that inconsistent results can be observed. The Emotional Spatial Cueing and the Dot-Probe Task are tasks aimed to evaluate the attentional orienting. Visual Search Task required focused attention, but it also involves the orienting of attention. The Emotional Stroop Task involves the executive system and assesses the resolution of a conflict.

Overall, 19 experiments employed an Emotional Spatial Cueing. This test has the advantage of better evaluating the attentional orienting, but also the processes of attentional disengagement (slower RTs to negative stimuli compared to positive or neutral stimuli only in the invalid trials) as different from attention engagement (faster RTs to negative stimuli compared to positive or neutral stimuli just in the valid trials). Among the analysed experiments, 73.68% (14 out of 19) that used this paradigm found evidence of an attentional bias in people with high trait anxiety. The null findings could be due to some methodological limitations, linked to the selection of participants (Broomfield and Turpin, 2005) or stimuli selected from a not validated database (Massar et al., 2011; Sagliano et al., 2014) or to the manipulation of the cue duration (Koster et al., 2006). Furthermore, it is possible to highlight how the evidence of an attentional bias was explicitly higher when pictorial stimuli, rather than lexical, were used as a cue (92.85% vs. 7.15%).

Finally, the results could be influenced by the duration of the cue (for example, Koster et al., 2006, Experiment 1; Koster et al., 2006, Experiment 2). Accordingly, facilitation of the attentional orienting was observed when the cue was brief, while a shift of attention from the emotionally relevant stimulus to the opposite location was found in the condition of longer cue duration. Although the attentional shift towards a new position cannot properly be considered as an indicator of attentional bias, it could be viewed as a maintenance factor of anxiety disorders, given the fact that it would not allow analysing in detail the information needed for a more realistic and rational assessment of the situation (Mogg and Bradley, 1998; Williams et al., 1997).

The experiments using the Dot-Probe Task were 23. The Dot-Probe Task has a structure similar to that of the Spatial Cue Task. However, it provides for the use of a double cue. In this way, the participants tend to expand the attentional focus towards the two positions, and then they move it towards the cue with a specific emotional value. The evidence of attentional bias emerged in 69.57% (16 out of 23) of the experiments. Also for this task, the inconsistency in the results could be primarily explained by the type of the stimuli. Studies that did not observe an attentional bias have used lexical stimuli (Lee and Knight, 2009) or pictorial stimuli selected from a not validate database (Wilson and MacLeod, 2003) as the double cue. By contrast, studies using stimuli chosen from a standardised database (Koster et al., 2004; Koster et al., 2006; Fox, 2002) observed an attentional bias.

The Visual Search Task allows to evaluate the fast detection of the target (i.e., attentional engagement), probably due to the involvement of an automatic process, and the difficulty of the disengagement of attention, which is revealed through the effect of distractors and that probably involve a voluntary process. This task was used only in 4 experiments, highlighting that 75% (3 out of 4) reported evidence of an attentional bias in people with high trait anxiety. These experiments used faces as stimuli (Fox et al., 2000; Matsumoto, 2010), while the only study that did not find an attentional bias used faces, but emotional expressions of these were modified through software for creating facial expressions (Derakshan and Koster, 2010), at this methodological aspect could be due to this inconsistent finding.

Finally, the Emotional Stroop Task is a complex task, involving the executive system and also allowing the evaluation of conflict resolution, attentional control, and cognitive flexibility. A total of 6 experiments have used this task, and 85.71% of these (5 out of 6) confirm an attentional bias, i.e. faster attentional engagement towards negative stimuli. The only study (Reinholdt-Dunne et al., 2009) that did not show an attentional bias employed words related to social anxiety (but social anxiety was not assessed) as stimuli, despite having selected the participants by the scores obtained in both the STAI and the Attentional Control Scale (Derryberry and Reed, 2002).

To date, the most used paradigm for evaluating the attentional bias is the Dot-Probe Task. This task, developed by MacLeod and colleagues (1986), is based on the assumption that an anxious subject placed in front of two stimuli (the double cue), having a different emotional value (for example, a face that expresses anger and a happy or neutral face) will preferably direct his/her attention to the negative stimulus (the threatening cue). Therefore, the response to the probe will be conditioned by this first attentional orienting. Although the Dot-Probe Task makes it more possible to discriminate the attentional bias in anxious individuals, the double cue does not allow us to understand precisely what the attentional bias is due, i.e., it does not let us know whether this is due to a higher engagement or a difficulty in the disengagement from the threatening stimulus.

The possibility of disambiguating the processes underlying the attentional bias would seem more guaranteed by the use of the Emotional Spatial Cueing. Although with the Emotional Spatial Cueing Task more inconsistencies are observed between the results. Such discrepancies would seem to be due above all to the type of stimulus chosen, rather than to the experimental paradigm. The Spatial Cueing Task allows analysing the components of the attentional orienting (Posner, 1980) since it enables us to estimate the indexes of engagement and disengagement from the threatening stimulus, which provide essential information on the nature of the attentional bias.

It is also important to highlight that a high limit of the tasks used to evaluate the attentional bias is psychometric. The reliability of Emotional Spatial Cueing is, to date, unknown, while for the Dot-probe Task, the reliability is very low (Van Bockstaele et al., 2014). Finally, few studies have used the Emotional Stroop Task and the Visual Search Task, but also, in this case, the reliability is unknown. Although the results are promising, they still do not allow to state which task is more sensitive to discriminate attentional bias. The Visual Search Task has been used above all in phobias. Using this paradigm in trait anxiety could provide further evidence for attentional bias.

It would be advisable to conduct studies aimed at analysing the psychometric properties of the different experimental paradigms used. Few authors have assessed the correlations between the various tasks. For example, Egloff and Hock (2003) administered both the Dot-Probe Task and the Emotional Stroop Task to 53 people not selected by the scores obtained at the STAI and observed no correlation between the data obtained with the two experimental tasks. It would be essential to carry out studies aimed at evaluating the validity of the construct of the various experimental paradigms.

Another methodological limit could be identified in the lack of standardization of the experimental tests and conditions. In particular, the literature analysis shows how different authors analyse the same data in differently. As highlighted by Bar-Haim et al. (2007), there would appear to be two ways of evaluating the attentional bias: analysing a difference between the groups in a given experimental condition or analysing a difference between the experimental conditions in a specific group. This different interpretation of the results does not contribute to a clarification of the phenomenon and does not help the understanding of the mechanisms underlying the attentional bias.

Finally, it is necessary to point out that the majority of studies on attentional bias in people with high state and trait anxiety were carried out on a population of university students, prevalently students in psychology.

Over the past decade, interest in the search for attentional bias has shifted more from basic research towards the results obtaining in clinical interventions aimed at modifying the attentional bias. This treatment, called Attentional Bias Modification (ABM), is aimed at the re-orientating of the attention from the threatening stimulus to other positive or neutral valence stimuli present in the environment. To implement this technique, the Dot-Probe Task is used. ABM training has been used in the last decade to reduce anxiety symptoms in various clinical populations, but the results are inconsistent (Heeren et al., 2015; McNally et al., 2013; Heeren et al., 2012; Klumpp and Amir, 2010). The ABM provides that the subjects are presented two stimuli (one neutral and one threatening) simultaneously and then a probe in the position of one of the two stimuli previously presented. The participants must respond as quickly as possible to the probe by pressing a key. In the version proposed by MacLeod, Rutherford, Campbell, Ebsworthy and Holker (2002), words are used as neutral and threatening stimuli, but other studies have used pictorial stimuli (i.e., Heeren et al., 2014).

The training has been modified experimentally in the various studies, using ABM. In general, three types of changes have been done: a) the presentation of the probe in the position occupied by the neutral cue in 95% of the trials (Heeren et al., 2014); b) appearance of the probe in the area of the stimulus with an emotionally negative value, for example in 95% of the trials (Heeren et al., 2014); c) the attendance of the probe for 50% of the time in the location of the neutral stimulus and about 50% of the time in the position of the negative stimulus (Heeren et al., 2014).

Usually, studies that have assessed the effects of ABM in reducing the attentional bias have never considered the role of both the executive system and the attentional control. Anxiety is often associated with a decreased ability in attention control (Derryberry and Reed, 2001; Eysenck et al., 2007; Derakshan and Eysenck, 2009). Attentional control mainly involves three components: the ability to focus attention, the ability to shift attention between different tasks and the cognitive flexibility (Derryberry and Reed, 2001).

It has been highlighted that individuals with high trait anxiety present difficulties in resolving a conflict. Specifically, Pacheco-Unguetti, Acosta, Callejas, and Lupiáñez (2010) administered the Attentional Network Test - Interaction (ANTI, Callejas et al., 2004) to 24 people with high trait anxiety and 24 people with low trait anxiety. The results did not show significant differences between the groups in both alerting and orienting systems. However, differences were found in the executive control: individuals with high trait anxiety had more difficulties in inhibiting the response to the Flanker Task (Eriksen and Eriksen, 1974). Similar results were also found by other authors (Berggren and Derakshan, 2014; Bishop, 2009).

Derryberry and Reed (2002) have used a game-like task, which included an "easy" and a "difficult" condition. In completing the "easy" version of the task, the subjects win 10 points if they responded quickly and accurately and no points if they responded slowly. During the "difficult" task, which involved the use of threatening cue, the participants lost 10 points if their answer was too slow, but did not gain any points if the answer was given too quickly. The results showed that people with high anxiety, compared to non-anxious ones, exhibit an attentional bias that manifests itself as a difficulty in the disengagement of attention, rather than facilitation in the attentional engagement.

Moreover, people with a low attentional control showed a higher difficulty in the disengagement of attention, while participants with a higher attentional control were able to shift attention from the cue to the target. Reinholdt-Dunne et al., (2009), using the Stroop Task, found that people with both high trait anxiety and low attentional control presented more difficulty in the disengagement of attention from the threatening face than from the face with neutral emotional expression.

More recently, Pacheco Unguetti, Acosta, Lupiáñez, Román, and Derakshan (2012) evaluated the attentional control in people with high state anxiety through the administration of the Go/No-Go Task. The task required participants to press a key, if in a series of letters there were the letters "O" or "X" (go trials), or do not press any key if there were not certain letters in the series of letters (no-go trials). Each test in the background contained the image of neutral or angry faces; each trial could also be at high perceptual load, i.e., the letters were all different, or at low perceptual load, where the letters were all the same. Regardless of state anxiety levels, all participants responded more slowly but with higher accuracy in the task with the high-perceptual load. Participants with high levels of state anxiety showed a lower ability to resolve the task when an angry face was represented in the background.

Furthermore, they made more errors when the task was at low perceptive load, i.e., when a higher attentional control was required to inhibit the response. People with low state anxiety, on the other hand, showed a better ability to inhibit the response (higher value of β), even when the experiment contained an angry face in the background. These results suggest that executive control could play a fundamental role in the phenomenon of attentional bias. Future research could further analyse this aspect, considering that the treatment is focused mainly on the modification of the attentional orienting.

Conclusions

Attentional bias is a complex phenomenon, still poorly understood. Concerning the attentional bias in trait anxiety, the results are still inconsistent.

Despite the attentional bias in the individuals with high trait anxiety has been extensively explored, further studies are required. In particular, it would be necessary to analyse the psychometric proprieties of the experimental paradigms, and it would be useful to improve the clinical interventions aimed at modifying the attentional bias (ABM training).

In conclusion, despite the presence of inconsistent results, most studies confirm the presence of an attentional bias in individuals with high trait-anxiety (73.07%). In most cases, the latter presents itself as a rapid attentional engagement, but in other cases, it manifests itself as a slower attentional disengagement (63.15% found a faster engagement and 36.85% a slower disengagement). Both of these processes would seem to indicate an attentional bias. However, it is not clear how rapid attentional engagement and slow attentional disengagement are influenced by some methodological choices, such as the type of stimuli used (words, faces, images), the duration of stimuli, the selection of standardized database stimuli or not standardized, the selection of participants, the type of experimental paradigm used. Concerning this last point, it should be emphasised that only the Emotional Spatial Cueing allows to evaluate the processes of engagement and disengagement at the same time and independently. Just the use of this paradigm, controlling all the other variables mentioned, will allow us to understand the nature of attentional bias in individuals with high trait-anxiety better.

CHAPTER 2

THE EMOTIONAL STROOP TASK TO ASSESS THE ATTENTIONAL BIAS IN TRAIT ANXIETY PEOPLE: THE ROLE OF DIFFERENT TYPES OF STIMULI AND THE INFLUENCE OF GENDER

Abstract

Attentional bias has been extensively studied in trait anxiety by using the Emotional Stroop Task. However, the results are inconsistent. These inconsistencies refer to the selection of stimuli or participants. In particular, it is not clear which stimulus type is more suitable to more carefully observe the attentional bias.

Moreover, although anxiety is more prevalent in females, gender differences have been poorly considered in previous research. The present study aims at comparing three types of stimuli (images, words and faces) in an Emotional Stroop Task. Furthermore, the study aimed at analysing gender differences in the attentional bias in people with high trait anxiety.

According to STAI scores, 34 (M/F= 17/17) participants with low trait anxiety and 37 (M/F= 18/19) participants with high trait anxiety were selected. The participants completed the Emotional Stroop Task, consisting of three blocks with three different stimuli: pictures, words, and faces. The results indicated that males, compared to females, had slower RTs in response to incongruent trials (i.e, threatening stimuli) when pictures were used as stimuli. Furthermore, within the group characterised by high trait anxiety, a higher Stroop effect was observed in males, compared to females, independently from the type of stimulus. These results suggest a difficulty in the disengagement of attention from the threatening stimulus in men, expressed by difficulty in resolving the conflict. Conversely, females show faster RTs in response to incongruent trials. This result could suggest a pattern of cognitive avoidance of the threatening stimulus. These findings are discussed in line with theories on attentional control.

Keywords: Emotional Stroop Task, Attentional Bias, Trait Anxiety, Emotion, Gender

Introduction

The cognitive system of anxious individuals would seem overly sensitive to environmental stimuli coming from outside (Mogg and Bradley, 1998). This specific sensitivity allow individuals with high trait anxiety to exhibit numerous biases, such as memory bias (Mogg, Mathews and Weinman, 1987; Williams, 1996; Mitte, 2008), judgment bias (Lucock and Salkovskis, 1988; Foa, Franklin, Perry and Herbert, 1996) and attentional bias (Beck and Clarke, 1997; Eysenck, 1992; Mathews, 1990; Mathews and MacLeod, 2002; Williams, Watt, MacLeod and Mathews, 1988; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, and van IJzendoorn, 2007). Attentional bias is the tendency to focus attention on threatening stimuli present in the environment, such as a facial expression or an emotionally salient picture (Mogg et al., 2004). When two or more stimuli compete for the individual's processing resources, it is more likely that individuals with high anxiety pay more attention to threatening or unpleasant stimuli than others. Furthermore, individuals with high trait-anxiety tend to interpret ambiguous information as dangerous (Mogg and Bradley, 1998; Williams et al., 1997). This increased attention to threatening stimuli may represent a factor of exacerbation and maintenance of anxiety disorders (Beck and Clarke, 1997; Eysenck, 1992; Mathews, 1990; Mathews and MacLeod, 2002; Williams, Watt, MacLeod and Mathews, 1988).

To assess attentional bias different experimental paradigms have been used, such as the Emotional Stroop Task (MacLeod, 1991), the Dot-Probe Task (MacLeod et al., 1986) and the Emotional Spatial Cueing (Fox et al., 2001). The Emotional Stroop Task (MacLeod, 1991) is a modified version of the classic Stroop task (Stroop, 1935). The participant is required to name the colour of words or pictures that have an emotional or neutral valence. If the person presents an attentional bias towards threatening stimuli, he/she will name the colours of the stimuli with negative valence more slowly and less accurately than those of neutral valence (MacLeod 1991). Later this definition has been revised by indicating two ways in which the attentional bias can occur when it is evaluated through the Emotional Stroop Task. The first is facilitation in the engagement of attention that should be indicated by faster RTs in response to threatening stimuli compared to neutral stimuli; the second condition is given by slower RTs in response to threatening stimuli compared to neutral stimuli and should mean difficulty in the disengagement of attention (Clarke, MacLeod and Guastella, 2013).

The Emotional Stroop Task was used for the assessment of attentional bias in people with various anxiety disorders. In particular, an attentional bias towards negative-emotional stimuli was identified in people with Social Anxiety (Amir et al., 2002; Spector et al., 2003; Grant and Beck, 2006; Peschard et al., 2013; Boehme et al., 2015), Generalized Anxiety Disorders (Becker et al., 2001; Chen et al., 2013), and Phobic Anxiety (Thorpe and Salkovskis, 1997; Elsesser et al., 2006).

A meta-analysis (Bar-Haim et al., 2007) found a mean effect size of the attentional bias assessed through the Emotional Stroop Paradigm (k= 70, d= 0.49, CI= 0.43-0.56). Concerning the trait anxiety, evaluated through the State-Trait Anxiety Inventory (Spielberg et al., 1983), many studies (Brosschot et al., 1999; Dresler et al., 2009; Egloff and Hock, 2003) have found an attentional bias towards threatening stimuli, using words as stimuli in people with high trait anxiety. Another study (Van den Hout et al., 1995) confirmed this attentional bias even by using a masking paradigm. Employing faces as stimuli, Reinholdt-Dunne et al. (2009) found an attentional bias in the naming of the colour of threatening faces. However, the same authors did not confirm the presence of attentional bias when they used words as stimuli. This contrary finding could be explained by considering the selection of the stimuli. Specifically, the authors selected words with a threatening social meaning, although they did not evaluate social anxiety. According to experimental data, it could be concluded that the Emotional Stroop Task is adequate to assess the attentional bias in people with high trait anxiety. However, it is not clear which stimuli (words, pictures or faces) are more sensitive to reveal the attentional bias. To identify what type of stimulus can capture attention in anxious individuals may have important implications for clinical research in this area.

Another question about the attentional bias research concerns gender differences, especially considering the higher prevalence of anxiety in women (Kessler et al., 2005). To our knowledge, a single study (Sass et al., 2010) has analysed gender differences in attentional bias by examining people with high trait anxiety through the Emotional Stroop Paradigm, using words as stimuli. The results showed different response patterns between males and females. In particular, non-anxious men showed early processing of threatening stimuli (at 100 ms), non-anxious women showed more late-stage processing (at 300 ms). Furthermore, the women with high trait anxiety displayed a large P100 amplitude (faster visual processing) independently of emotional valence of stimuli than anxious men.

The main goal of the present study is to analyse whether there is a type of stimulus (picture, word or face) more sensitive to induce an attentional bias assessed by an Emotional Stroop Task in people with high trait anxiety. Also, this study aims at evaluating whether there are any gender differences regarding the attentional bias observed in people with high vs. low anxiety trait, and their responses to the different types of emotional stimuli (pictures, words or faces) used. The following predictions can be advanced. Firstly, according to the results that highlight an attentional bias both with words (e.g. Dresler et al., 2009, Egloff and Hock, 2011) and with faces (Reinholdt-Dunne et al., 2009), we expected to confirm the bias for these types of stimuli and we hypothesised that attentional bias could also be present with pictures. Second, considering that faces have a higher biological significance (Hinojosa et al., 2015; Burrows, 2008, Hadj-Bouziane et al., 2008) and that pictures can evoke emotion more easily than words (Kensinger and Schacter, 2006), it is hypothesized that Attentional bias will be higher for faces and pictures, than for words. Third, considering that women tend to experience emotions more intensely (Bradley et al., 2001; Fernández-Berrocal et al., 2012; Deng et al., 2016), it is assumed that in individuals with high trait-anxiety attentional bias will be higher in females, than males.

Method

Participants

One hundred university students participated in the experiment (M/F= 50/50). They were recruited at Sapienza University of Rome and had a mean age of 24.05 (± 2.93). According to the 30th and 70th percentile indicated by the Italian validation of the State-Trait Anxiety Inventory-Form Y (STAI, Spielberger, 1983; Pedrabissi and Santinello, 1989), 34 (M/F= 17/17) participants with low trait anxiety and 37 (M/F= 18/19) with high trait anxiety were selected. The groups Low Trait Anxiety and High Trait Anxiety differed significantly in both state anxiety ($F(1,67)= 12.52$; $p< .0001$; $\eta^2=$

.16) and trait anxiety scores (F(1,67)= 278.95; p< .0001; η^2= .81). The Female and Male differed significantly in state anxiety (F(1,67)= 4.08; p= .05; η^2= .05) and in trait anxiety (F(1,67)= 7.87; p< .001; η^2= .11). The interaction Gender x Group on trait anxiety was significant (F(1,67)= 28.61; p< .0001; η^2= .30), and indicates higher scores in trait anxiety in the females than the males in individuals with high trait anxiety (F(1,67)= 34.70; p< .001; η^2= .33). Table 1 shows means, and standard error for male and female with high and low trait anxiety.

Table 1. Means, and standard error (SE) of both State and Trait Anxiety scores in the females and males with low and high trait Anxiety.

		State Anxiety		Trait Anxiety	
		Mean	SE	Mean	SE
Low Trait Anxiety	Female	37.41	2.30	31.76	1.18
	Male	33.06	2.37	34.70	1.15
High Trait Anxiety	Female	46.00	2.24	57.26	1.16
	Male	40.95	2.30	47.84	1.15

State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI; Spielberger, 1983; Pedrabissi and Santinello, 1989) is a questionnaire for the evaluation of state and trait anxiety. It includes 20 items for the assessment of state anxiety and 20 items for the assessment of trait anxiety. The subjects responded to 4-point Likert-type response scales. The scores range from 20 to 80. The 70th percentile corresponds to a score ≥43 in males and ≥48 in females, and the 30th percentile corresponds to a score ≤35 in males and ≤37 in females.

Apparatus

The experiment was designed and presented through the E-Prime software 2.0 (Schneider, Eschman, & Zuccolotto, 2002) on a 17 CTR monitor with a screen resolution of 1024 × 768 pixels. The participants' answers were recorded through a standard keyboard.

Emotional Stroop Task

Stimuli

Following Koster et al. (2006), ten threatening pictures and ten neutral pictures were selected by the International Affective Picture System (Lang et al., 1999). The pictures (Neutral: 1440, 1603, 5200, 5300, 5480, 5551, 5631, 5661, 7182, 7237; Threatening: 3000, 3010, 3060, 3069, 3170, 6230, 6350, 6550, 9410, 9940) were presented with the dimension of 8 cm in width and 6 cm in height. Ten faces with a threatening expression and four faces with neutral expression were selected from the Maccari, Martella, Marotta, Sebastiani, Banaj, Fuentes and Casagrande (2014) database. The faces were 4 cm in width and 6 cm in height. For the word selection, the words of the pool proposed by Mathews et al. (1995) were initially translated into the Italian language, and then they were evaluated by 20 university students of psychology. Each word was judged according to a value of emotionality and threat, on a 10-step Likert scale. After this assessment, ten words, which achieved a mean score of 5.46 ± 0.93 in the emotionality value and a mean score of 6.78 ± 0.79 in the threat, were selected as threatening words (e.g. Bara: "Coffin"). Another ten words, which achieved a mean score of 1.34 ± 0.25 in the emotionality value and a mean score of 1.73 ± 0.45 in the threat, were selected as neutral words (e.g. Sala: "Hall"). The words were balanced for the frequency of use and length. The words were presented in uppercase, with Calibri (Body) font and a font size of 50 pt. All stimuli were presented in one of four colours: red, yellow, green or blue.

Procedure

The participants were tested in a silent room. The distance from the participants' eyes and the PC screen was of about 50 cm. A fixation cross 3° x 2.5° (degrees of visual angle) was presented for 500 ms. After that, the target stimulus appeared on the screen for 2000 ms or until the participant's response. The participant's task was to determine as quickly and accurately as possible, by pressing a key on the keyboard, the colour of the target stimulus presented on the screen. The keys (a, z, l, m) corresponding to each colour were marked with the corresponding colour on the keyboard. The task involved two conditions: Neutral Valence and Threatening Valence. Half of the trials were Neutral Valence and half Threatening Valence. The experiment included three blocks of pictures, words and faces. Each experimental block comprised 15 training trials and 160 experimental trials. The three blocks were counterbalanced across participants. Figure 1 shows the sequence of events in the experiment.

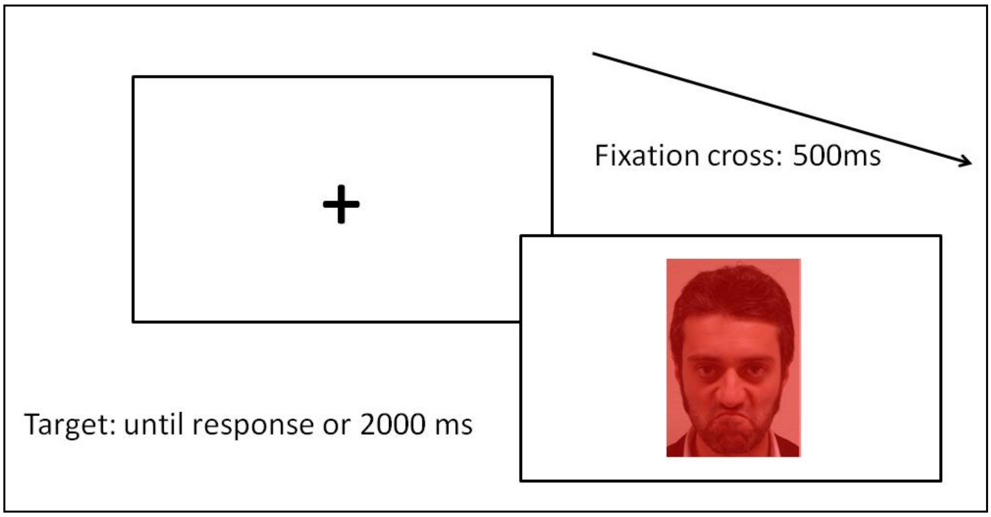


Figure 1. The sequence of events in the experiment.

General procedure

The participants were selected through public announcements. They signed the informed consent, and the Local Research Ethics Committee approved the study. First, the participants completed the STAI and then they underwent the Emotional Stroop Task.

Data analysis

RTs of less than 200 ms and more than 1200 ms have been eliminated (Fox et al., 2002), reflecting respectively anticipated and delayed responses. The mean correct RTs and percentage of correct responses were subjected to a 2 (Group: High trait anxiety, Low trait anxiety) x 2 (Gender: Females, Males) x 3 (Stimulus: Pictures; Words; Faces) x 2 (Valence: Neutral Valence; Threatening Valence) analysis of variance (ANOVA). To analyze the role of each type of stimulus, RTs of the single experimental block were subjected to a Group) x Gender x Valence) ANOVA.

The Stroop effect was calculated, by subtracting the mean RTs of the Neutral Valence trials to the mean RTs of the Threatening Valence trials. Given the high variability of data, the Stroop index score was transformed into z scores. Low scores in the Stroop effect suggest a higher ability to solve the conflict, while high scores in the Stroop effect indicate higher difficulty in solving the conflict.

Mean Stroop indexes were analysed by a Group x Gender x Stimulus ANOVA. Slower RTs on Threatening Valence trials and higher Stroop effect for threatening stimuli have been considered as indicators of attentional bias because these scores reflect a difficulty in the disengagement of attention. Conversely, faster RTs in the Threatening Valence trials and a lower Stroop effect could suggest facilitation in the engagement of attention (Clarke, MacLeod and Guastella, 2013).

Planned comparisons analysed the effects and interactions. The significance level was established according to an α value of .05.

Results

Reaction Times

Comparison between stimuli

The table 2 reports mean (± SE) of RTs in the groups of participants for each experimental conditions.

Table 2. Means, and Standard Error (SE) of RTs in the groups of participants for each experimental condition.

		High Trait Anxiety				Low Trait Anxiety			
		Males		Females		Males		Females	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Words	Neutral	663.49	27.79	675.02	28.84	665.11	26.85	677.30	30.01
	Threatening	676.43	26.65	682.03	27.66	678.08	25.75	684.04	28.79
Pictures	Neutral	751.57	28.45	699.23	29.53	742.17	27.49	741.87	30.73
	Threatening	803.64	32.45	702.99	33.68	758.33	31.35	769.58	35.05
Faces	Neutral	681.72	27.40	650.36	28.44	684.34	26.47	670.95	29.60
	Threatening	717.90	29.26	674.83	30.36	708.87	28.27	702.71	31.60

The ANOVA revealed significant effects for Stimuli ($F(2,106)= 34.38$; $p= .0001$; $\eta^2= .40$) and Valence ($F(1,53)= 50.03$; $p= .0001$; $\eta^2= .50$). RTs were slower when the stimulus was a Picture, rather than an Word ($F(1,53)= 47.00$; $p= .0001$; $\eta2= .48$) or a Face ($F(1,53)= 51.50$; $p= .0001$; $\eta2= .51$; Figure 2). Furthermore, RTs were faster in the Neutral Valence condition, compared to the Threatening Valence condition (691.93 ms vs 713.31ms).

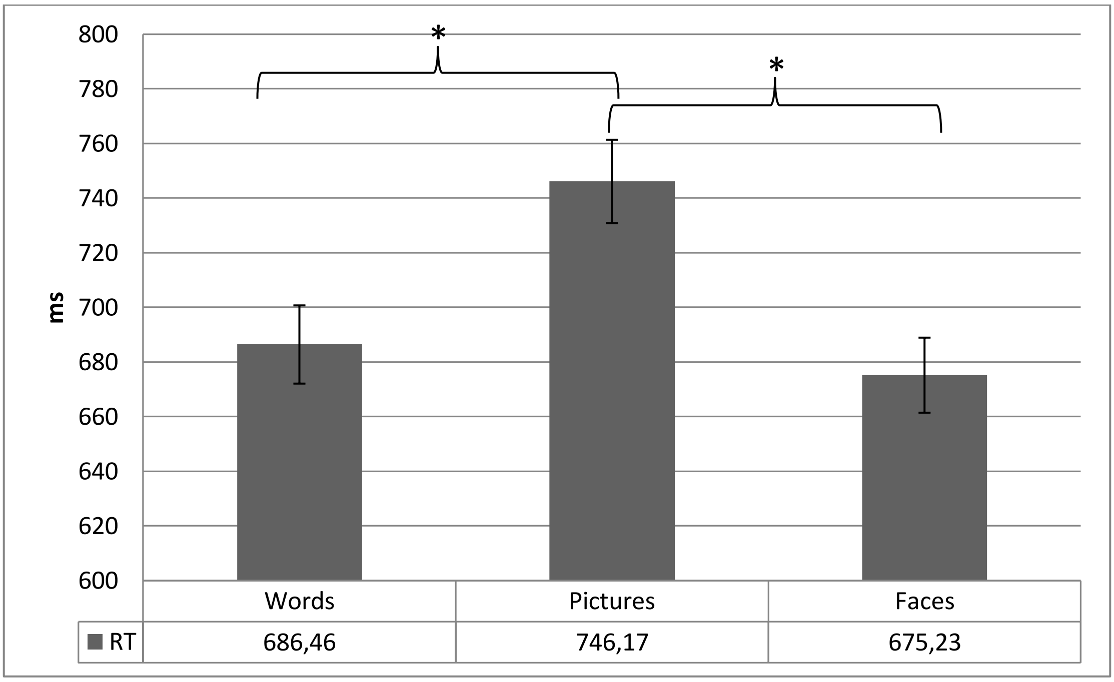


Figure 2. Means and standard errors of the RTs for each Stimulus condition.

The Stimulus x Valence ($F(2,106)= 3.76$; $p= .02$; $\eta 2= .07$) interaction revealed that the difference between Neutral Valence and Threatening Valence trials was lower when the stimuli were words (670ms vs 680.23ms; $F(1,53)= 5.18$; $p= .02$; $\eta 2= .09$) than Pictures (733.71ms vs 758.63ms; $F(1,53)= 14.42$; $p= .0001$; $\eta 2= .22$), or Faces (671.84ms vs 701.08ms; $F(1,53)= 44.19$; $p= .0001$; $\eta 2= .47$).

The Gender x Stimulus interaction ($F (2,106)= 3.12$; $p= .04$; $\eta 2= .06$) revealed that both Females (728.42ms vs 679.68ms; $F(1,53)= 11.31$; $p= .001$; $\eta 2= .18$) and Males (763.93ms vs 670.78ms; $F(1,53)= 47.96$; $p< .0001$; $\eta 2= .49$) had slower RTs when the stimuli were Pictures than Word. Further both Females (728.42ms vs 674.72ms; $F(1,53)= 17.69$; $p= .0001$; $\eta 2= .26$) and Males (763.93ms vs 698.20ms; $F(1.53)= 30.75$; $p< .0001$; $\eta 2= .38$) had slower RTs when the stimuli were Pictures than Faces. However, these effects were higher for males than females. The Group x Gender x Stimulus interaction was marginally significant ($F (2,106) = 2.56$; $p= .08$; $\eta 2= .05$).
To better analyse the effect of the stimulus, a Group x Gender x Valence ANOVA was separately performed for each type of stimuli.

Pictures

The main effect of Valence was significant ($F(1,53)= 14.41$; $p= .0001$; $\eta2= .22$) and confirmed faster RTs in the Neutral Valence than Threatening Valence condition (733.71 ms vs 758.63 ms). The interaction Group x Gender x Valence was significant ($F(1,53)= 5.20$; $p= .02$; $\eta2= .10$). To better understand this interaction, a Gender x Valence ANOVA was performed separately for each Group.

The ANOVA on the Group of participants with high trait anxiety showed significant effects for the Gender ($F (1,25)= 4.80$; $p= .04$; $\eta2= .16$) and the Valence ($F(1,25)= 7.25$; $p< .01$; $\eta2= .22$). RTs were faster in the Females compared to the Males (701.11 ms vs 777.60 ms) and in the Neutral Valence trials compared to Threatening Valence trials (725.39 ms vs 753.31 ms). The Gender x Valence interaction was also significant ($F(1,25)= 7.25$; $p= .03$; $\eta2= .18$) and it showed slower RTs in the males than in the Females, only in the Threatening Valence trials ($F(1,25)= 7.08$; $p= .01$; $\eta2= .22$). Furthermore, only in the males RTs were significantly different in the Neutral Valence and Threatening Valence trials (751.57 ms vs 803.64 ms; $F(1,25)= 13.06$; $p< .001$; $\eta2= .34$).

The ANOVA on the Group of low trait anxiety participants confirmed only the main effect of Valence ($F(1,25)= 7.48$; $p< .01$; $\eta2 = .23$), with faster RTs in response to Neutral Valence trials compared to Threatening Valence trials (742.02 ms vs 763.95 ms).

Figure 3 reports the mean RTs in the congruent and incongruent trials for males and females of participants with high or low trait anxiety.

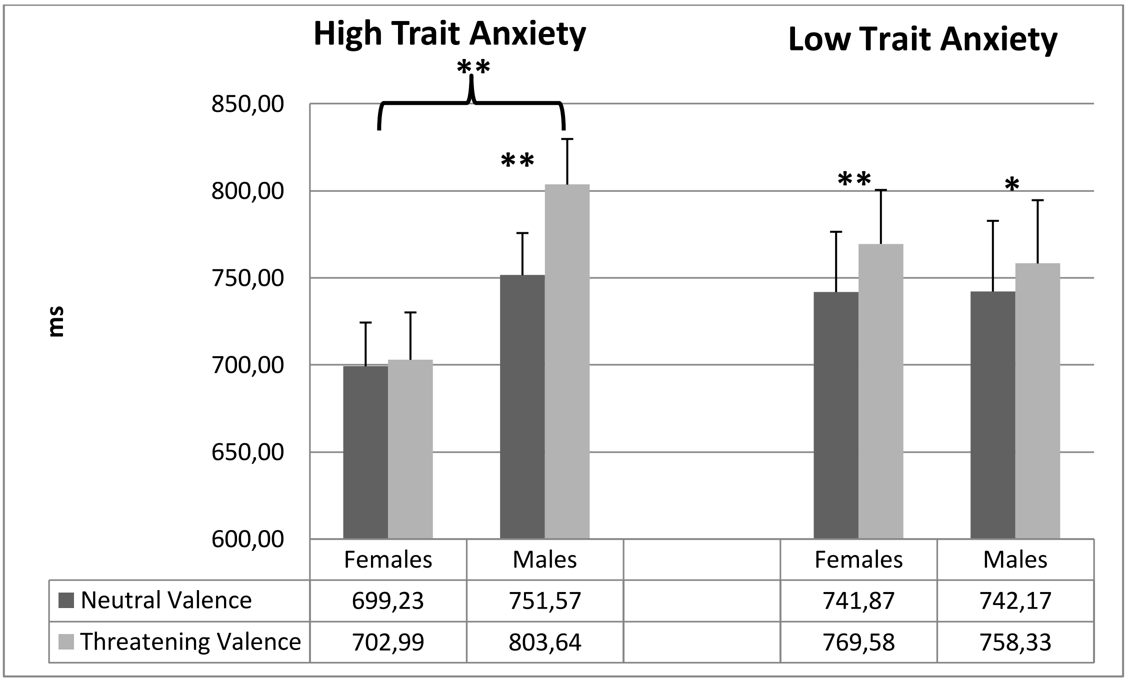


Figure 3. Means and standard error of RTs in the congruent and incongruent trials for males and females of participants with high or low trait anxiety.

Faces

The ANOVA confirmed only the effect of Valence ($F(1,53)= 48.90$; $p< .0001$; $\eta2= .50$), which revealed faster RTs in the Neutral Valence than in the Threatening Valence trials (674.82ms vs 704,28ms). The other effects or interactions were not significant ($F<2$).

Words

The ANOVA confirmed only the effect of Valence ($F(1,53)= 7.24$; $p< .001$; $\eta2= .12$), which revealed faster RTs in the Neutral Valence compared to the Threatening Valence trials (671.15 ms vs 682.67 ms). The other effects or interactions were not significant ($F<2$).

Stroop effect

Table 3 shows means and standard error of the Stroop effect for each group and each condition.

The Group x Gender interaction was significant ($F(1,67)= 3.71$; $p= .06$; $\eta2=.07$) and revealed a higher Stroop effect in males than in females only in the group of participants with high trait anxiety, but this difference was marginally significant (0.21 ms vs -0.24 ms; $F(1,67)= 3.88$; $p= .06$; $\eta2 =.13$; Figure 3).

Table 3. Means and standard errors of the Stroop effect (z-scored) for each group of participants and type of stimulus.

		Pictures		Words		Faces	
		Mean	SE	Mean	SE	Mean	SE
High Trait Anxiety	Females	-0.43	0.26	-0.15	0.10	-0.14	0.08
Low Trait Anxiety	Females	0.17	0.13	-0.15	0.08	0.09	0.08
High Trait Anxiety	Males	0.40	0.25	0.07	0.05	0.18	0.13
Low Trait Anxiety	Males	-0.12	0.10	0.02	0.02	-0.16	0.26

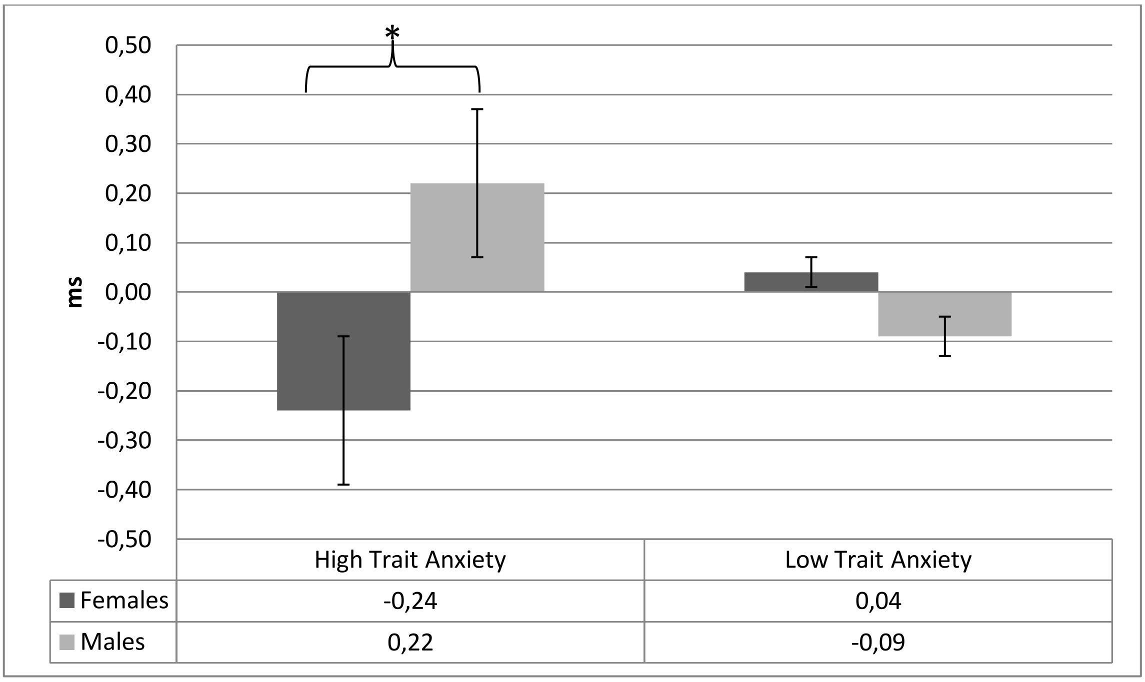


Figure 4. Means and Standard error of the Stroop effects in females and males with high or low trait anxiety.

* p= .06

Accuracy

Table 4 shows the mean and standard errors of the number of correct responses of each participants' group, for each experimental condition.

The effects of Stimulus ($F(2,100)= 2,73$; $p= .07$; $\eta 2= .05$) was marginally significant. The participants' responses were more accurate for faces than pictures ($F(1,50)= 4,82$; $p= .03$; $\eta 2= .09$; 0.963 vs 0.956). The Gender x Stimulus interaction ($F (2,100)= 3.54$; $p= .03$; $\eta 2= .07$) was significant and it shows more accurate responses for faces than words in males ($F(1,50)= 7,69$; $p< .01$; $\eta 2= .13$; 0.969 vs 0.955). The Gender x Group x Valence ($F (2,100)= 5.33$; $p= .02$; $\eta 2= .10$) interaction was significant. To better understand this interaction, a Gender x Stimulus x Valence ANOVA was performed separately for each Group.

The ANOVA on the Group of participants with high trait anxiety confirms the effect of Stimulus ($F(1,25)= 4.33$; $p= .02$; $\eta 2= .15$), which revealed response more accurate for faces than words ($F(1,25)= 10,82$; $p< .001$; $\eta 2= .30$; 0.969 vs 0.956) and pictures ($F(1,25)= 4,16$; $p= .05$; $\eta 2= .14$; 0.969 vs 0.959). The Gender x Valence interaction ($F(1,25)= 5,76$; $p= .03$; $\eta 2= .19$) was significant and it indicates response more accurate for Threatening Valence compared to Neutral Valence in males ($F(1,25)= 9,12$; $p< .001$; $\eta 2= .27$; 0.966 vs 0.952).

The ANOVA on the Group of participants with low trait anxiety no shows main effects or interactions ($F< 2$).

Table 4. Means, and Standard Error (SE) of percentage of correct responses in the groups of participants for each experimental condition.

		High Trait Anxiety				Low Trait Anxiety			
		Males		Females		Males		Females	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Words	Neutral	0.942	0.009	0.970	0.010	0.960	0.009	0.950	0.010
	Threatening	0.955	0.010	0.959	0.010	0.964	0.010	0.954	0.011
Pictures	Neutral	0.945	0.011	0.958	0.011	0.969	0.010	0.934	0.012
	Threatening	0.975	0.008	0.959	0.009	0.961	0.008	0.946	0.009
Faces	Neutral	0.969	0.007	0.967	0.008	0.969	0.007	0.944	0.008
	Threatening	0.967	0.006	0.971	0.007	0.970	0.006	0.948	0.007

Discussion

The first aim of the present study was to analyse whether there is a type of stimulus (picture, word or face) more sensitive to induce an attentional bias assessed by an Emotional Stroop Task in people with high or low trait anxiety. Concerning this goal, the results have shown slower RTs in response to pictures stimuli, rather than words or faces. This result may depend on the biological value of the faces. The expressions of the faces can contribute to the interpretation of both social situations and the emotional state of people (Schacht and Sommer, 2009). Again, the emotional understanding of facial expression and word meaning would appear to be automatic and involuntary processes (Whitney, McKay, Kellas, & Emerson, 1985; Batty and Taylor, 2003; Schupp et al., 2004; Kissler et al., 2009).

Conversely, the pictures are more complex stimuli and could involve more elaborated processes (Kensinger and Schacter, 2006). These results do not differ according to gender, in fact, males and females show faster RTs in response to words and faces, compared to pictures. The lack of gender differences agrees with the results of other studies (Below, Skinner, Fearrington, & Sorrell, 2010; Logan & Johnston, 2010).

Furthermore, there was a difference in the size of the stimuli. While the size of the faces was 6 cm in width and 4 cm in height, the size of the pictures was 8 cm in width and 6 cm in height. Thus, the effect of the colour could be smaller or larger for the different types of stimulus.

Indeed, previous studies (Shokri et al., 2016; Malek et al., 2013) did not find gender differences in a Classic Stroop paradigm. The present study would seem to confirm this result in people with low trait anxiety. This is not the case when we consider people with high trait anxiety. Our results highlight a higher Stroop effect in male participants with high trait anxiety, regardless of the type of stimulus used. Moreover, the analysis separately made on each kind of stimulus indicates a higher difficulty in the resolution of the conflict by male subjects with high trait anxiety in the trials using pictures as stimuli. A previous study (Egloff and Schmukle, 2004) did not observe gender differences in an Emotional Stroop Task paradigm, using words. Our findings replicate these results, no gender differences in response to the Emotional Stroop Task that uses words or faces as stimuli have been observed. Our findings also agree with those of another study (Elsesser et al., 2006), which found an attentional bias in people with phobic anxiety using pictures selected by the IAPS. We can conclude that the stimuli that seem most sensitive to the assessment of attentional bias in anxious individuals are pictures.

The results on the accuracy also confirmed the higher difficulty in the conflict resolution in the male participants with high trait anxiety. Indeed, the males with high trait anxiety showed more accurate responses when the stimuli were threatening than neutral. Despite the other studies showed higher accuracy in normal female than male (Mekarski et al., 1996; Sarmany, 1977), this results concern the individuals with high trait anxiety.

The results of this study would seem to indicate the presence of an attentional bias only in the Males, compared to the Females. This result is contrary to the hypothesis. Indeed, it was assumed the presence of the Attentional Bias in the female, because the women tend to experience emotions more intensely. However, it could be suggested that males and females exhibit different patterns of attentional bias. In particular, while the men show difficulty in resolving the conflict, the women would seem to be unaffected by the threatening stimuli. There is no significant difference between Neutral Valence and Threatening Valence trials only in the group of females with high trait anxiety. This finding highlights a quick response to the threatening stimuli that could be interpreted as an avoidance of the threat. Women with high trait anxiety, faced with a threatening stimulus, would provide a quick response to move on to the next trial.

A result in contrast with findings of other studies concerns the lack of attentional bias towards the faces. Reinholdt-Dunne et al. (2009) highlighted a difficulty in resolving the conflict about faces in people with high trait anxiety. However, it should be noted that Reinholdt-Dunne et al. (2009) divided participants into four groups, based on the scores obtained on both the STAI and the Attentional Control Scale (Derryberry and Reed, 2002). The purpose of the study was to verify whether individuals with both high trait-anxiety and high attention control had solved more easily Stroop interference. Our study does not take into account the attentional control, even if this aspect could be of fundamental importance in the study of conflict resolution. In particular, people with good attentional control should be less affected by Stroop interference (Derryberry and Reed, 2002).

A limit of the study could be the low number of participants. Even if the number of participants is similar to that of other studies, an increased number of subjects could lead to more stable results. Furthermore, another limit could be the different scores in trait anxiety between females and males. Indeed, the women show a higher score in the trait anxiety.

This study is the first that analyses gender differences in people with high trait anxiety and different types of stimuli through an Emotional Stroop paradigm, used to evaluate the attentional bias to threatening stimuli. Furthermore, the strength of the study is represented by the participants' selection. In the experiments on the attentional bias in high trait anxiety, the participants come mainly from the Faculty of Psychology. In the present study, the participants were selected from different university faculties. This aspect could be considered a strong point because it allows a better generalisation of the result to the university students tout court, to the extent permitted by a non-representative sample for the student's population.

Future studies could analyse attentional control besides the participants' level of anxiety and gender. In particular, some studies seem to confirm an association between attentional control and emotion regulation (O'Bryan et al., 2017; Tortella-Feliu et al., 2014; Vine and Aldao, 2014). This issue seems to be very relevant if we consider that women usually have higher competence in emotions regulation (Gross and John, 2003). It could be hypothesised that increasing the ability of attentional control in anxious individuals may improve emotional skills. Improving emotional skills may result in a recovery of the individual's trait anxiety. Developing cognitive training to improve conflict resolution skills could help reduce attentional bias in anxious individuals and could improve emotional regulation skills.

In conclusion, this study shows that attentional bias in people with high trait anxiety is more present in males than females and when pictures, rather than faces or words, are used as stimuli. It will be essential to verify whether the same results are also present using a different experimental paradigm like a Dot-Probe Task or an Emotional Spatial Cueing Task.

CHAPTER 3

THE DOT-PROBE TASK TO ASSESS THE ATTENTIONAL BIAS IN TRAIT ANXIETY PEOPLE: THE ROLE OF DIFFERENT TYPES OF STIMULI AND THE INFLUENCE OF GENDER

Abstract

The attentional system of anxious individuals is particularly sensitive to stimuli evaluated as threatening. A gold standard for the assessment of the attentional bias in trait anxiety is the Dot-Probe Task. Numerous experiments that utilized this paradigm have not fully clarified the nature of attentional bias. It could be assumed that the inconsistencies in the results can be due to the selection of stimuli or participants. Therefore, the main goal of this study was to compare three types of stimuli (pictures, words and faces), selected from standardized databases.

Furthermore, considering that anxiety has a high prevalence in females than males, the study aims at analysing gender differences concerning attentional bias.

From one hundred university students, 30 (M/F= 15/15) with low trait anxiety, and 30 (M /F= 13/17) with high trait anxiety were selected, according to STAI scores. All participants completed a Dot-Probe Task, consisting of three randomized blocks, each with different types of stimuli (pictures, words or faces). The results showed an attentional bias for people with high trait anxiety in the pictures experiment. However, men and women exhibit different patterns, while males showed a rapid allocation of attention towards threatening stimuli, females presented an avoidance of the threatening stimulus. The results are discussed according to theories on attentional bias and clinical implications.

Keywords: Dot-Probe Task; Attentional Bias; Trait Anxiety; Emotion; Gender Differences

Introduction

Many studies have found that individuals with high trait anxiety present an attentional bias towards threatening stimuli (Mathews and Mackintosh, 2000; Mathews and MacLeod, 2002; Williams, Watt, MacLeod and Mathews, 1988; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, and van IJzendoorn, 2007). To assess attentional bias, a reliable and elective paradigm is the Dot Probe Paradigm (MacLeod et al., 1986; Bradley et al., 1997; Salmenik et al., 2007). In the Dot-Probe Task, two stimuli (one threatening and one neutral) are presented in two locations. Subsequently, a probe could replace the position of threatening stimulus or neutral stimulus. The participant has to respond to the probe. The trial could be congruent (when the probe appears in the same location of the threatening stimulus) or incongruent (when the probe replaces the location of the neutral cue). Faster reaction times (RTs) on congruent trials indicate an attentional bias towards the threatening stimulus. However, a meta-analysis (Bar-Haim et al., 2007) found that the evaluation of attentional bias through the Dot-Probe Task in anxious individuals has a medium-low effect (d= .37, CI= 0.28, 0.46), furthermore test-retest reliability is low (Aday and Carlson, 2018; Staugaard, 2009), and Puls and Rothermund (2018) questioned the sensitivity of the Dot-Probe Task in catching attentional bias.

The Dot-Probe Task has been extensively employed for the assessment of attentional bias in high trait anxiety and in other anxiety disorders, such as social anxiety disorder (eg, Stevens et al., 2013; Rossignol et al., 2013), generalized anxiety disease (eg, Bradley et al., 1999: Mohlman et al., 2013) or in people affected by phobias (eg, Lipp and Derakshan, 2005; Vrijsen et al., 2009). Many authors have found evidence of attentional bias in people with high trait anxiety, using different types of cues. For example, some authors observed an attentional bias by using words (MacLeod and Mathews 1988; Yiend and Mathews 2001; Keogh et al., 2001; Brosschot et al., 1999) or pictures (Mogg and Bradley 1999; Bradley et al., 2000; Fox, 2002) as stimuli. The only study (Wilson and MacLeod, 2003) that found no difference between individuals with high trait-anxiety and non-anxious people used faces as stimuli. However, this inconsistency could be due mainly to the selection of stimuli. The faces were not selected from a standardized database.

With the Dot-Probe Task the attentional bias was also observed by varying the duration of the stimuli: 100 ms (Koster et al., 2006), 500 ms (Bradley et al 1998, Koster et al., 2006) and 1250 ms (Bradley et al. 1998, Koster et al., 2006).

Only one study compared the differences in the use of different stimuli in a Dot-Probe Paradigm (Lee and Knight, 2009). The authors administered this task to young adults and elderly, comparing three different types of stimuli: pictures, faces and words. Furthermore, the experiment included two conditions: not masked (the stimulus was presented for 1500 ms) and masked (the stimulus was presented for 20 ms for young adults and 50 ms for the elderly). The results showed a lower bias index score (given by the mean difference in reaction times between congruent and incongruent trials) in the elderly subjects for the words in the masked condition, compared to the words in the non-masked condition. No differences were found among the three types of stimuli. However, the masking paradigm could have made the task too difficult for the elderly population, included in the study. Furthermore, the study does not show any effects on the group of university students. Considering that this kind of studies is mainly conducted on a population of university students, it would be necessary to clarify which types of stimuli could induce an attentional bias in this population.

Many studies have shown that women, compared to men, experience negative emotions more intensely (Bradley et al., 2001; Fernández-Berrocal et al., 2012; Deng et al., 2016). Furthermore, women show a higher sensitivity towards stimuli characterised by a negative valence (Gohier et al., 2013) and an increase in the startle reflex produced by negative stimuli (Bradley et al., 2001). Few studies have analysed gender differences about attentional bias. Pintzinger et al. (2016) explored gender differences in university students, by using a Dot-Probe Task. The results showed a cognitive avoidance in males and females for positive stimuli lasting 100 ms. Furthermore, women showed a cognitive avoidance also to negative stimuli lasting 500 ms. However, the trait anxiety was not considered.

Another study (Carr et al., 2016) evaluated gender differences in attentional bias before and after a stressful event. The men showed a lower attentional bias towards the faces in a Dot-Probe Task. On the other hand, women presented a pattern of avoidance before the stressful event and a higher congruence effect with the threatening stimuli after the stressful event. Recently, a study (Kinney et al., 2017) analysed the attentional bias in Generalized Anxiety Disorder (GAD). The authors used a cueing paradigm in a group of women and men with GAD and found an effect of validity in women only in the presence of words with positive valence, but not with negative or neutral valence. It could be assumed that both gender differences and stimuli selection can play a fundamental role in research on attentional bias. Consequently, the general aim of the study proposes to analyse the gender difference in the attentional bias in the individuals with high vs. low anxiety, and the more suitable stimulus for the evaluation of the attentional bias.

Firstly, the current study aims to compare three different stimuli (words, faces and pictures) with a Dot-Probe paradigm in people with high or low trait anxiety. Some authors suggest that words and pictures are more functional stimuli in this paradigm than faces (Keogh et al., 2001; Wilson and MacLeod, 2003; Lee and Knight, 2009). These data contrast with findings that identify faces as stimuli with a high ecological value (Risko et al., 2012). Thus, the need for a further study comparing stimuli is evident. According to results observed by many authors (MacLeod and Mathews, 1988; Brosschot et al., 1999; Yiend and Mathews, 2001; Keogh et al., 2009; Lee and Knight, 2009; Koster et al. (2005), a higher congruence effect is expected in experiments that use words and pictures as stimuli, rather than faces.

The second aim of the study is to analyse the gender differences between people with high vs. low trait anxiety by using a Dot-Probe Task paradigm. According to the results on emotions (McRae et al., 2008) and on the attentional bias (Carr et al., 2016; Kinney et al., 2017), the attentional bias should be higher in the group of anxious women, compared to anxious men. According to some studies (Pintzinger et al., 2016; Carr et al., 2016), which showed that women tend to avoid threatening stimuli, we hypothesize that the bias score index will be negative in women, according to a cognitive avoidance, while it will be positive in men, according to an attentional engagement.

Method

Participants

The same one hundred university students who participants in the experiment reported in Chapter 2 participated in the current experiment (M/F= 50/50; mean age: 24.05± 2.93). The participants completed the Emotional Stroop Task and the Dot-Probe Task in a counterbalanced order. They were recruited at the Sapienza University of Rome. Based on the scores obtained at the State-Trait Anxiety Inventory-Form Y (STAI, Spielberger, 1983), 30 (M/F= 15/15) participants with low trait anxiety and 30 (M/F= 13/17) with high trait anxiety were selected, according to the 30th and 70th percentile indicated by the Italian validation of the STAI (Pedrabissi and Santinello, 1989). The groups high trait anxiety and low trait anxiety differed significantly in state anxiety scores ($F(1,55)= 10.45$; $p< .001$; $\eta2 = .16$) and trait anxiety ($F(1,55)= 181.12$; $p< .0001$; $\eta2 = .76$). The Group x Gender interaction on trait anxiety score was significant ($F(1,55)= 13.83$; $p< .001$; $\eta2 = .19$), and suggest higher scores in the females with high trait anxiety compared to males with high trait anxiety ($F(1,55)= 11.47$; $p< .01$; $\eta2 = .17$). Table 1 shows means, standard errors, and ANOVA results for the participants with high and low trait anxiety.

Table 1. Means, and standard error (SE) in the females and males with low and high trait Anxiety.

		State Anxiety		Trait Anxiety	
		Mean	SE	Mean	SE
Low Trait Anxiety	Female	35.33	2.55	31.20	1.41
	Male	34.33	2.55	34.93	1.41
High Trait Anxiety	Female	46.48	2.40	55.93	1.38
	Male	39.77	2.74	48.76	1. 51

Dot-Probe Task

Stimuli

The stimuli were identical to the Emotional Stroop Task.

Procedure

The participants were tested in a silent room. The distance from the participants' eyes and the PC screen was of about 50 cm. A fixation cross 3° x 2.5° (degrees of visual angle) was presented for 500 ms, and it was flanked on the right and the left by two boxes 8 cm in width and 6 cm in length (10.5° x 3°). Later, a threatening stimulus and a neutral stimulus was presented in the two boxes for either 100 ms or 500 ms. After an inter-stimulus interval of 100 ms, a target letter (0.9 ° x 0.9 °) appeared on the screen until the participant's response or up to 1500 ms. In 50% of the trials the condition was congruent, i.e., the target appears in the same position as the threatening cue. In the other 50% of the trials the condition was incongruent, i.e., the target is presented at the position of the neutral cue. Participants were required to keep their eyes on the fixation cross and respond as quickly and accurately as possible, discriminating the letter on the screen, an M or an N, by pressing two buttons on the keyboard. The target letters were presented in uppercase, with Calibri (Body) font and a font size of 24 pt. The participants completed three blocks. Each block included a different cue condition: words, pictures, and faces. For each experimental block, 160 experimental trials and 15 training trials were presented. The three blocks were counterbalanced between subjects. Figure 1 shows the sequence of events of the experiment.

General procedure

The participants were selected through public announcements. They signed the informed consent. After completed the STAI, then they underwent the Dot-Probe Task. The Local Research Ethics Committee approved the study.

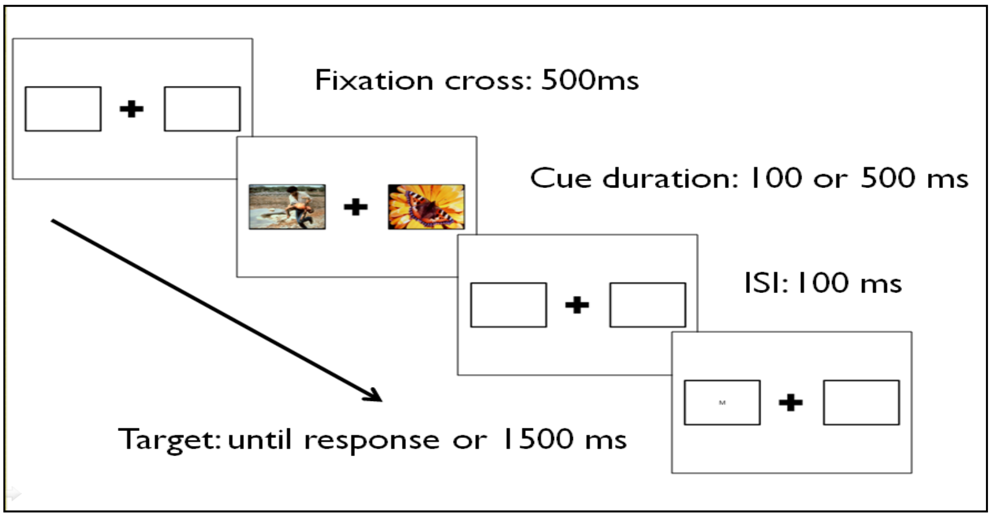


Figure 1. The sequence of events in the Dot-Probe Task.

Data analysis

According to a (Fox et al., 2002), only mean RTs of the correct responses above 200 ms and below 1200 ms were considered.

Mean RTs of correct responses and percentage of correct responses were subjected to a 2 Group (High trait anxiety, Low trait anxiety) x 2 Gender (Males, Females) x 3 Stimuli (Words, Pictures, Faces) x 2 Cue duration (100 ms; 500 ms) x 2 Congruence (Congruent; Incongruent) analysis of variance (ANOVA). To analyse the role of each type of stimulus, RTs of each single experimental block were subjected to a Group x Gender x Cue duration x Congruence.

According to Fox (2002), the attentional bias index was calculated, using the following formula: (RTs incongruent trials - RTs congruent trials) / 2. Positive scores indicate a faster response to the probe that appears at the location of the threatening stimulus. In contrast, negative scores suggest avoidance of negative valence stimuli. The attentional bias index has been subjected to a Group x Gender x 3 Stimuli x Cue duration ANOVA. Subsequently, the same analysis design was performed separately for each type of stimulus.

To analyse the effects and interactions, planned comparisons were used. The significance level was established according to an α value of .05.

Results

Reaction times

The table 2 reports means (± SE) of RTs in the groups of participants for each experimental conditions.

Table 2. Means and standard errors (SE) of RTs in the groups of participants for each experimental conditions.

			High Trait Anxiety				Low Trait Anxiety			
			Males		Females		Males		Females	
			Mean	SE	Mean	SE	Mean	SE	Mean	SE
Words	Congruent	100ms	533.73	17.40	557.98	15.22	558.04	16.20	544.56	16.80
	Incongruent	100ms	533.05	18.74	547.02	16.39	557.79	17.45	544.43	18.06
	Congruent	500ms	512.28	19.24	537.45	16.98	530.90	18.08	526.40	18.71
	Incongruent	500ms	510.45	17.72	527.67	15.50	528.75	16.50	512.85	17.08
Pictures	Congruent	100ms	556.73	18.48	550.24	16.16	556.12	17.20	553.04	17.81
	Incongruent	100ms	552.62	24.63	543.99	21.55	559.24	22.94	546.61	23.74
	Congruent	500ms	523.60	21.82	521.71	19.08	527.32	20.32	523.44	21.03
	Incongruent	500ms	528.70	22.15	518.46	19.37	541.72	20.62	522.12	21.34
Faces	Congruent	100ms	547.77	21.28	570.02	18.61	588.40	19.82	610.77	20.51
	Incongruent	100ms	570.49	20.60	566.01	18.01	589.55	19.18	603.39	19.85
	Congruent	500ms	530.59	17.81	546.48	15.57	556.28	16.58	569.68	17.16
	Incongruent	500ms	537.67	19.39	552.80	16.95	575.86	18.05	562.16	18.68

Comparison between stimuli

The ANOVA showed significant effects of Stimulus (F(2,110)= 15.95; p< .0001; η2= .23; Figure 2) and Cue duration (F(1,55)= 108.03; p< .0001; η2 = .66). Slower RTs were observed in response to Faces, compared to both Pictures (F(1,55)= 24.77; p< .0001; η2= .31) and Words (F(1,55)= 14.82; p< .0001; η2= .21). Further, an alertness effect was observed with faster RTs for the cue duration of 500 ms compared to 100 ms (534.39 ms vs 560.09 ms).

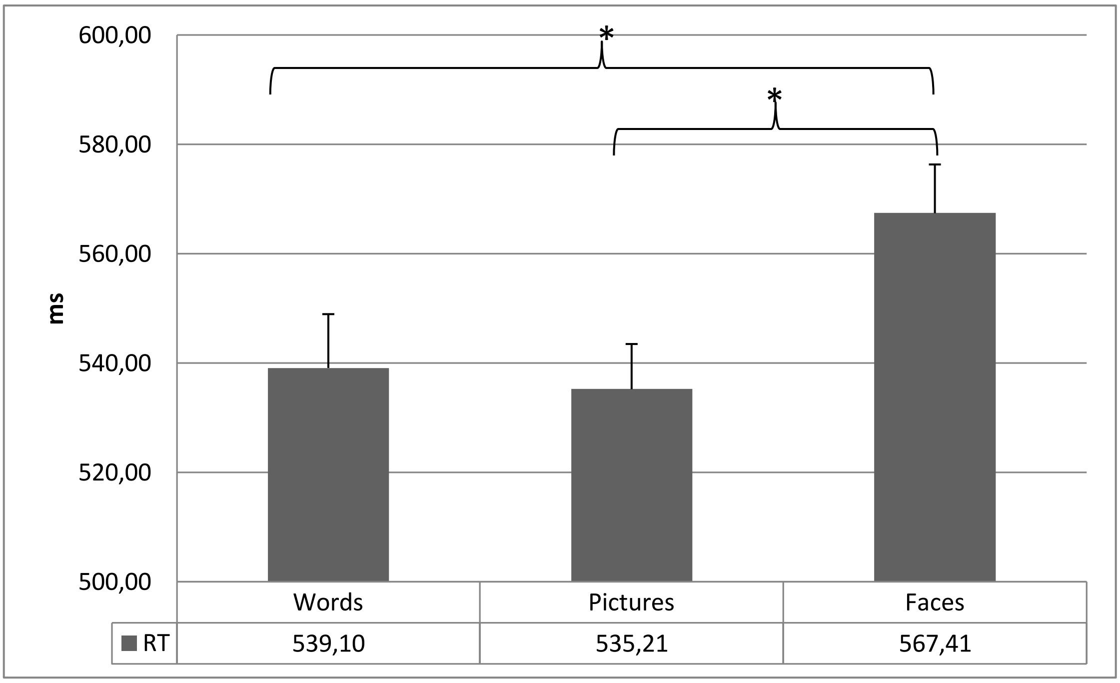


Figure 2. Means and Standard Error of RTs for each type of stimulus.

The Group x Stimulus interaction was marginally significant (F(2,110)= 2.55; p= .08; η2= .05). In the group with low trait anxiety, RTs were slower in response to the Faces with respect to both the pictures (F(1,55)= 22.98; p< .0001; η2= .29) and the words (F(1.55)= 15.28; p< .0001; η2= .22). In the Group with high trait anxiety, RTs were slower in response to Faces than Pictures (F(1,55)= 4.99, p< .02, η2= .08). The Gender x Congruence interaction (F(1,55)= 8.32; p< .005; η2= .13; figure 3) showed slower

RTs in the Congruent trials, compared to the Incongruent trials, for females (F(1,55)= 4.42; p< .04; η2= .07; 551.03 ms vs 545.63 ms), while for males RTs were slower in the Incongruent trials, compared to Congruent trials (F(1,55)= 3.93, p< .05, η2= .07, 548.82 ms vs 543.47 ms).

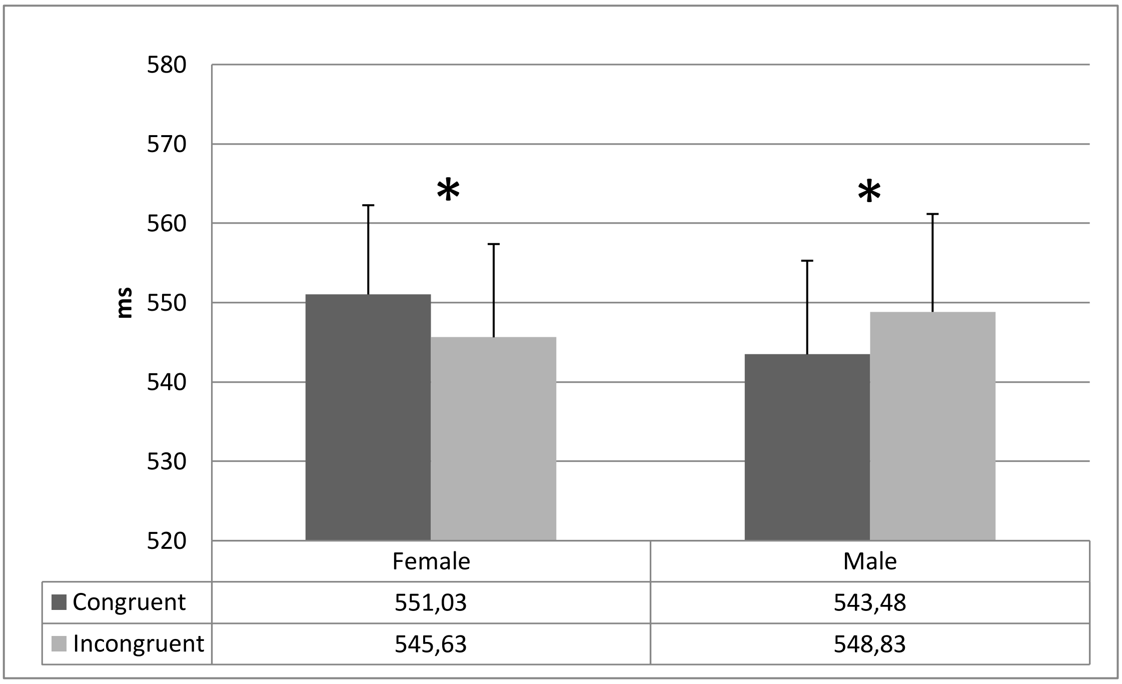


Figure 3. Mean and Standard Error of RTs for Females and Males in Congruent and Incongruent condition.

Pictures

The ANOVA confirmed the effect for the Cue duration (F(1,55)= 40.23; p< .0001; η2= .42), while the Congruence was marginally significant (F(1.55)= 3.23; p= .07; η2 = .05). The Gender x Congruence interaction (F(1,55)= 9.41; p< .003; η2= .15) was significant, while the Group x Gender x Congruence x Cue duration (F(1.55)= 5.31; p= .07; η2 = .08; Table 3) was marginally significant. To better analyse these interactions, ANOVAs were separately performed in the two groups of participants.

In the Group with high trait anxiety, the effects of Cue duration (F(1,28)= 28.64; p< .001; η2= .50), and Congruence (F(1,28)= 4.24; p< .04; η2 = .14) were confirmed. The Gender x Congruence interaction was marginally significant (F(1,28)= 3.37; p= .07;

$\eta 2 = .11$), whereas the Gender x Congruence x Cue duration was significant ($F(1,28) = 4.84$; $p < .03$; $\eta 2 = .15$).

An ANOVA Gender x Congruence was separately conducted for the Cue duration of 100 ms and Cue duration of 500 ms. For the Cue duration of 100 ms, the effect of Congruence was confirmed ($F(1,28) = 3.93$; $p = .05$: $\eta 2 = .12$). The Gender x Congruency interaction was significant ($F(1,28) = 8.97$; $p = .005$; $\eta 2 = .24$), showing faster RTs in the Congruent trials, than Incongruent trials, in the Males ($F(1,28) = 10.93$; $p < .001$; $\eta 2 = .28$). No effect was significant for the Cue duration of 500 ms.

In the Group with low trait anxiety, the effect of Cue duration ($F(1,28) = 18.15$; $p < .0001$; $\eta 2 = .40$) was confirmed, while the Gender x Congruence interaction ($F(1, 28) = 6.27$; $p < .01$; $\eta 2 = .19$), indicates faster RTs in the Congruent trials, than in the Incongruent trials, only in the Males ($F(1,27) = 4.54$; $p < .04$; $\eta 2 = .14$).

Words

The ANOVA confirmed the effect of the Cue duration ($F(1,55) = 44.70$; $p < .0001$; $\eta 2 = .44$). The other effects or interactions were not significant ($F < 2$).

Faces

The ANOVA confirmed the effect of the Cue duration ($F(1,55) = 63.70$; $p < .0001$; $\eta 2 = .53$). The other effects or interactions were not significant ($F < 2$).

Attentional bias index

Table 3 reports mean (± SE) of Attentional Bias Index in the groups of participants for each experimental conditions.

The effect of the Gender ($F(1,55) = 8.32$; $p < .005$; $\eta 2 = .13$) revealed a negative index for the Females (-2.70 ms) and a positive index for the Males (2.67 ms). The effect of Stimulus was marginally significant ($F(1,55) = 2.60$; $p = .07$; $\eta 2 = .05$). To better analyse this effect, an ANOVA was separately performed for each stimulus.

Table 3. Mean and SE of Attentional Bias Index in the groups of participants for each experimental conditions.

		High Trait Anxiety				Low Trait Anxiety			
		Males		Females		Males		Females	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Words	100ms	-2.06	5.53	-3.12	4.83	1.56	5.15	-3.21	5.33
	500ms	2.55	4.63	-1.62	4.05	7.20	4.31	-0.66	4.46
Pictures	100ms	11.36	3.77	-2.31	3.30	0.58	3.51	-3.69	3.63
	500ms	3.54	3.79	3.16	3.31	9.79	3.53	-3.75	3.65
Faces	100ms	-0.34	4.35	-5.48	3.80	-0.12	4.04	-0.06	4.19
	500ms	-0.91	4.25	-4.89	3.72	-1.07	3.96	-6.77	4.10

Pictures

The effect of the Gender was confirmed ($F(1,55) = 9,41$; $p = .003$; $\eta 2 = .15$). The interaction Group x Gender x Cue duration was significant ($F(1,55)= 5.31$; $p< .02$; $\eta 2 = .09$; Table 4). To better analyse this interaction, separate ANOVA were carried out for each Group.

In the Group with high trait anxiety, the ANOVA showed a marginally significant effect for the Gender ($F(1,28)= 3.87$; $p= .07$; $\eta 2= .11$) and a Gender x Cue duration interaction ($F(1,28)= 4.84$; $p< .04$; $\eta 2= .15$). This interaction revealed a significant difference between Females and Males when the Cue duration was at 100 ms (-2.31 ms vs 11.36 ms; $F(1,28)= 8.97$; $p< .005$; $\eta 2= .24$; Figure 4) . In the Group with low trait anxiety, only the effect of the Gender ($F(1,27)= 6.47$; $p< .02$; $\eta 2= .19$) was confirmed.

A one-sample t-test indicated that the bias score of the males with high trait anxiety when the Cue duration was at 100 ms differ significantly from zero ($t(12)= 3.69$; $p< .01$). Therefore, the bias score of the males with low trait anxiety when the Cue duration was at 500 ms differ significantly from zero ($t(14)= 2.54$; $p= .02$).

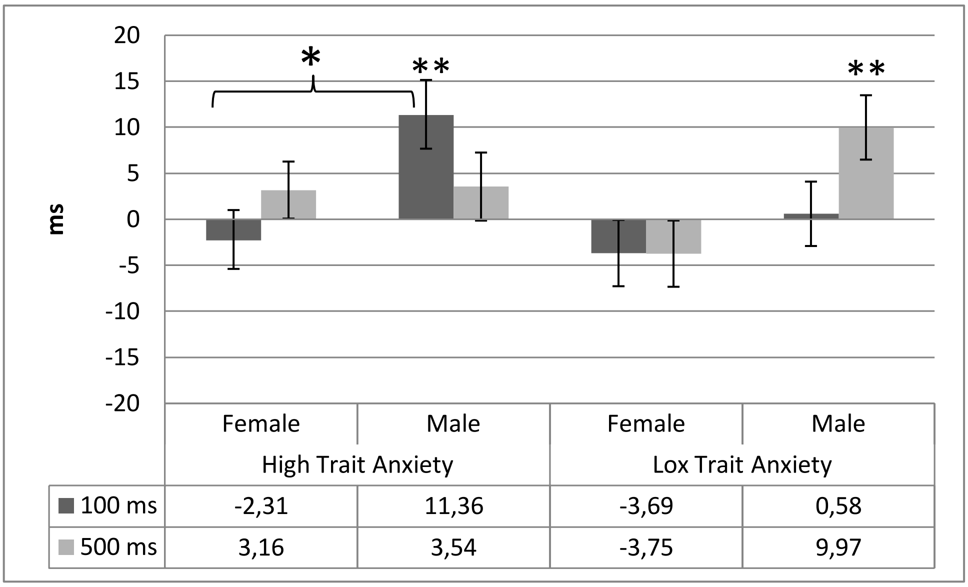


Figure 4. Mean and Standard Error of the attentional bias index in females and males of the two groups of participants with high and low trait anxiety for the two types of Cue duration. *= p< .005; **= bias score tested against zero was significant.

The analyses separately carried out on Words and Faces did not show any effect or interaction (F< 2).

Accuracy

Table 4 shows the mean and standard errors of the percentage of correct responses of each participants' group, for each experimental condition.

The Stimulus x Cue duration ($F(2,110)= 3.68$; $p= .03$; $\eta2= .06$) and the Gender x Stimulus x Cue duration ($F(2,110)= 3.36$; $p= .04$; $\eta2= .06$) interactions were significant. To better understand this interaction, a Stimulus x Cue duration x Congruency ANOVA was performed separately for each males e females.

The ANOVA on the Males confirms the Stimulus x Cue duration ($F(2,54)= 5.03$; $p< .01$; $\eta2= .16$) interaction, which revealed response more accurate for words than faces ($F(1,27)= 5,15$; $p< .05$; $\eta2= .16$; 0.951 vs 0.934) when the duration of the cues was long. The ANOVA on the Females no shows main effect or interactions (F< 2).

Table 4. Means, and Standard Error (SE) of (percentage of correct responses in the groups of participants for each experimental condition.

			High Trait Anxiety				Low Trait Anxiety			
			Males		Females		Males		Females	
			Mean	SE	Mean	SE	Mean	SE	Mean	SE
Words	Congruent	100ms	0.933	0.015	0.957	0.014	0.945	0.015	0.939	0.015
	Incongruent	100ms	0.948	0.018	0.943	0.016	0.942	0.017	0.941	0.017
	Congruent	500ms	0.927	0.017	0.936	0.015	0.951	0.015	0.934	0.016
	Incongruent	500ms	0.960	0.013	0.939	0.012	0.953	0.013	0.934	0.013
Pictures	Congruent	100ms	0.958	0.018	0.942	0.016	0.930	0.017	0.937	0.017
	Incongruent	100ms	0.912	0.026	0.938	0.023	0.915	0.024	0.940	0.025
	Congruent	500ms	0.936	0.025	0.942	0.022	0.914	0.023	0.935	0.024
	Incongruent	500ms	0.930	0.027	0.950	0.023	0.904	0.025	0.939	0.026
Faces	Congruent	100ms	0.942	0.018	0.948	0.016	0.947	0.017	0.938	0.018
	Incongruent	100ms	0.937	0.020	0.938	0.017	0.944	0.018	0.933	0.019
	Congruent	500ms	0.961	0.017	0.939	0.015	0.947	0.015	0.936	0.016
	Incongruent	500ms	0.942	0.020	0.925	0.018	0.924	0.019	0.939	0.020

Discussion

The study was aimed at clarifying whether which emotional stimulus (word, picture or face) elicit a higher attentional bias in people with high or low trait anxiety. The results have shown that the faces result in slower RTs. However, this effect is not related to a specific emotion but occurs when two faces are presented simultaneously on the screen regardless of emotion. Slower RTs in response to faces, rather than other stimuli, have already been highlighted in other studies that have used this database (Federico et al., 2013; Federico et al., 2016). In particular, slower RTs were observed in response to photographs of a face, compared to drawn faces and pictures of fish in university students (Federico et al., 2013) and children (Federico et al., 2016). However, the results are ambiguous in the literature. Indeed, another study (Bagott et al., 2011), using a different database, observed faster RTs in word processing, rather than faces.

Further, other authors observe how the processing of faces would seem to be an automatic process, compared to the processing of words (Beall and Herbert, 2008, Palermo and Rhodes, 2007). It is, however, necessary to stress that this result does not have a close relationship with the emotional valence of the stimulus. The rapid and automatic processing of the face stimuli is almost always associated with negative valence (Beall and Herbert, 2008, Palermo and Rhodes, 2007).

Concerning the attentional bias, the stimulus that would seem to have had more effective results for the evaluation of attentional bias is the picture. However, the selection of stimuli must be taken into account. Although both the faces and the pictures have been selected from standardized databases, they present different values of valence and arousal. According to the criteria suggested by Koster et al. (2006), the pictures selected by the IAPS have an emotional valence of less than 2 and an arousal higher than 6, while the faces selected from the database of Maccari et al. (2014) have an emotional valence of 3.02 and a mean arousal of 5. The stimuli selected by Koster and colleagues (2006) had medium threatening valence and arousal. It could be assumed that this lower emotional relevance may have contributed to determine slower RTs in the face experiment.

Results on the attentional bias index suggest, within the group of people with high trait anxiety, a cognitive avoidance of the threatening stimulus for the females when the cue duration was brief. This finding agrees with the results of another study (Mogg et al., 1997), which highlighted a cognitive avoidance of the threat when the duration of the stimulus was brief in people with high state anxiety. Conversely, the males with high trait anxiety would seem to anchor their attention to the threatening stimuli more quickly, and thus they show an automatic pre-attentive process (Mogg et al., 1997; Williams et al., 1988). This study is the first that analyses gender differences about trait anxiety by considering different types of stimuli and by using a Dot-Probe Task. Further insights would be useful, to better understand the nature of this response pattern. The cognitive avoidance strategy observed in the females group could be interpreted within the vigilance-avoidance pattern (Eysenck, 1997). According to this theoretical model, after an automatic and early allocation of attentional resources towards a stimulus evaluated as threatening (vigilance state), the anxious individuals would implement an avoidance strategy, to alleviate their level of anxiety (avoidance status). This active strategy for the reduction of the attentional bias towards the threat could contribute to the maintenance of the anxiety disease (Eysenck, 1997).

Another relevant result concerns gender differences emerged independently of trait anxiety. In particular, a different pattern is observed in males and females in response to the congruent and incongruent trials. The men show the classic congruence effect, i.e. minor RTs in response to Congruent trials, compared to the Incongruent trials. On the contrary, women show higher RTs in response to Congruent trials, compared to Incongruent trials. One could hypothesise that this response pattern agrees with cognitive avoidance. The females would seem to have a higher attentional anchorage towards the neutral stimulus and not towards the threatening stimulus. Only when the target appears at the position of the threatening stimulus, the subject disengages attention from the location of the neutral stimulus and shifts towards the position of the target. This finding is consistent with the different pattern observed in function of a short and a long cue duration. While cognitive avoidance occurs at the short interval, the delayed of disengagement shows at long interval (Koster et al., 2006). Indeed, this result agrees with the results observed by Carr et al. (2016), which observed a pattern of avoidance in women in a Dot-Probe Task at the baseline, before a stress induction test, and with the study by Pintzinger et al. (2016), which showed a cognitive avoidance to the threatening stimuli lasting 500 ms only in females.

The result of accuracy showed more accurate responses when the cues were words than faces, in males participants at longer cues. Furthermore, this result is consistent with the RTs results, that indicated slower RTs when the cues were words than faces at the longer cue duration (530.34 ms vs 520.60 ms). The lower rates of accuracy observed when the cues were faces could be explained by the higher biological value of this type of stimuli (Hinojosa et al., 2015; Burrows, 2008, Hadj-Bouziane et al., 2008). Consequently, the faces could evoke emotion more easily than words (Kensinger and Schacter, 2006) and lead to a higher number of errors.

The main limit of the study could be the number of participants. An increase in experimental subjects could lead to more substantial results. Secondly, the females with high trait anxiety show more level of anxiety of the males with high trait anxiety. The different level of trait anxiety could have affected the results concerning gender difference.

Further studies would be needed to clarify whether there is an election stimulus for the assessment of attentional bias. This field of research should be taken into consideration, if we evaluate the emerging studies concerning the Attentional Bias Modification procedure (ABM; MacLeod et al., 2002). This procedure is based on the Dot-Probe Task paradigm, which is modified experimentally for the training of re-orientation of attention. Generally, in the experimental group, the test is transformed so that the target is presented in the position corresponding to the neutral cue for the 75% of the trials. In this way, the subject should undergo a re-orientating of the attention from negative stimuli to neutral stimuli. However, this procedure could be appropriate for anxious males, but not for anxious females. Therefore, in studies evaluating the effectiveness of the ABM procedure on anxiety, it would be essential to consider the gender of the participants.

CHAPTER 4

THE EMOTIONAL SPATIAL CUEING TASK TO ASSESS THE ATTENTIONAL BIAS IN TRAIT ANXIETY PEOPLE: THE ROLE OF DIFFERENT TYPES OF STIMULI AND THE INFLUENCE OF GENDER

Abstract

Some theories have suggested a higher orienting of attention toward threatening stimuli in anxious individuals, i.e. a rapid allocation of attentional resources toward stimuli with negative valence. This attentional bias has been investigated by using different stimuli and paradigms, obtaining inconsistent results that could depend on the different stimuli used and the gender of participants. As far as we know, no study has investigated the impact of three different stimuli in an Emotional Spatial Cueing Paradigm in males and females with high vs. low trait anxiety. To fill this gap, the aims of the present study were to analyse the attentional bias in individuals with high vs. low trait anxiety, by using an Emotional Spatial Cueing with three different types of emotional stimuli. Furthermore, the study aimed at analysing gender differences regarding the attentional bias.

According to STAI scores in trait-anxiety, 37 (M/F= 18/19) participants with high trait anxiety and 31 (M/F= 16/15) participants with low trait anxiety were selected. The participants completed the Emotional Spatial Cueing Task, consisting of 3 blocks with three different stimuli: pictures, words and faces. Attentional indexes of engagement and disengagement were calculated in each block according to Koster et al. (2006). The results on Engagement and Disengagement scores for each Experiment showed that participants with high trait anxiety presented lower attentional engagement than the participants with low trait anxiety in the Experiment using Faces as stimuli. The results and their clinical implications are discussed in the context of cognitive models of attention.

Keywords: Emotional Spatial Cueing; Attentional Bias; Trait Anxiety; Emotion; Gender differences

Introduction

Emotions strongly affect the cognitive system of individuals (Ohman, Flykt, & Esteves, 2001; Phelps et al., 2006). Many cognitive theories assume that anxious individuals are particularly sensitive to emotionally stimuli present in the environment and present an attentional bias towards threatening stimuli (Beck and Clarke, 1997; Eysenck, 1992; Mathews, 1990; Mathews and MacLeod, 2002; Williams, Watt, MacLeod and Mathews, 1988; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, and van IJzendoorn, 2007). In particular, it is hypothesised that individuals with high trait-anxiety direct their attention early towards stimuli valued as threatening and present difficulties in disengaging attention from such stimuli (Fox, Russo, Bowles and Dutton, 2001; Fox, Russo and Dutton, 2002).

Posner (1980) assumed that the attentional orienting could be divided into three components: engagement, shift, and disengagement. In particular, the individual would initially shift the attention to the position indicated by a cue, then he/she will engage his/her attention to that position and, if the next stimulus appears in an uncued position, the attention would be disengaged from the first position to move into the new position in which the stimulus appeared. A paradigm for assessing attentional engagement and disengagement in individuals with high trait-anxiety is the Emotional Spatial Cueing (Fox, Russo, Bowles and Dutton, 2001). In this task, a spatial cue, consisting of a stimulus with threatening or neutral valence, is presented in one of two possible locations on the screen. Then, on one of the two locations, a neutral target stimulus is shown, to which the participants must respond by pressing a key.

The attentional bias could arise in different ways. A faster attentional engagement occurs when the reaction times (RTs) on valid trials (the target stimulus is presented in the cue position) is faster for threatening than neutral cues. Furthermore, a difficulty in the disengagement of attention from the threatening stimulus is present when, on invalid trials (the target stimulus is presented at the opposite position to the cue), RTs are slower for threatening than neutral cues.

In the first case, we will refer to the engagement index, in the second case we will refer to the disengagement index (Koster et al., 2006). A faster attentional engagement could contribute to a higher awareness of a threatening stimulus in the environment. Conversely, a difficulty in the disengagement of attention could lead to the maintenance of anxiety, from the moment in which it hinders a more realistic analysis of the environment and the surrounding situation. Therefore, it may result in a worse performance in attentional tasks.

However, the literature has not unequivocally highlighted whether the attentional bias of anxious individuals reflects more an attentional engagement or a difficulty in attentional disengagement. Some studies show difficulty in disengagement from the threatening stimulus. In particular, in participants with high trait anxiety, higher RTs are observed in response to threatening stimuli (e.g., Yiend and Mathews, 2001) or a higher cue validity index computed by considering only stimuli with a negative emotional valence (Fox et al., 2002; Koster et al., 2006) or a higher disengagement score in people with high trait anxiety (Sagliano et al., 2014). In contrast, other experiments have observed a facilitation of attentional engagement in people with high trait anxiety, which is reflected in faster RTs in response to threatening trials (Broomfield and Turpin, 2005) or in a higher engagement scores (Sagliano et al., 2014; Azarian et al., 2016; Massar et al., 2011; Koster et al., 2006).

These inconsistencies may be due to methodological differences between the studies. In particular, the stimuli used are different. While a difficulty in disengagement is highlighted both with the use of pictures (Yiend and Mathews, 2001; Sagliano et al., 2014) or faces as cues (Fox et al., 2002; Mogg et al., 2008), a facilitation of attentional engagement was observed using pictures selected from validated databases (Koster et al., 2006), faces (Massar et al., 2011) or pictures of human figures (Azarian et al., 2016). The stimulus selection could be of particular importance for the study of attentional bias. Given the inconsistencies in the results, it would be advisable to try to standardise more the procedures for administering the experimental paradigms with the use of standardised databases. This would allow a better understanding of the nature of attentional bias, and it could lead to identifying a more suitable stimulus for the assessment of the attentional bias.

Another aspect that has not been sufficiently analysed in the research on the attentional bias concerns the gender differences. Koster et al. (2006) explored gender differences in a Spatial Cueing paradigm. The results showed a higher cue validity index for trials that used as cue moderately threatening stimuli in the anxious males, compared to non-anxious males. A recent study (Kinney et al., 2017) employed an Emotional Spatial Cueing with healthy males and females. The results showed a quicker response in the valid, compared to the invalid trials, for positive emotions. However, this study did not consider the anxiety levels of the participants. Further studies would be needed to clarify whether there is a gender difference in attentional bias in trait anxiety.

Despite the numerous experiments conducted on the attentional bias in individuals with high trait-anxiety, it is still not clear whether there is a type of stimulus (lexical or pictorial) mote suitable to measure the attentional bias. Therefore, the present study aims to evaluate the attentional bias in people with high vs. low trait anxiety, by administering the Emotional Spatial Cueing and using three types of stimulus: pictures and faces selected from a validated database and words subjected to a preliminary validation procedure. Furthermore, the study aims to analyse gender differences in people with high or low anxiety in the attentional bias.

Considering the findings that have shown an attentional bias when faces (Fox et al., 2002; Mogg et al., 2008) and pictures (Yiend and Mathews, 2001; Sagliano et al., 2014; Koster et al., 2006) were used as stimuli, we expect a higher attentional bias towards these stimuli, compared to words. Secondly, according to results indicating an attentional bias both as a difficulty in disengagement (Fox et al., 2002; Mogg et al., 2008), and as a facilitation of attentional engagement (Koster et al., 2006; Azarian et al., 2016), it is hypothesised that attentional bias can occur in both modes. Finally, considering the higher sensitivity to negative stimuli of females (Deng et al., 2016), a higher attentional bias is expected in women than men.

Method

Participants

One hundred and five university students, different from those who performed the Emotional Stroop and Dot-Probe Tasks, in the above studies, were recruited at the "Sapienza" University of Rome. According to the 30th and 70th percentile indicated by the Italian validation of the State-Trait Anxiety Inventory-Form Y (STAI, Spielberger, 1983; Pedrabissi and Santinello, 1989), 68 participants were selected, 31 (M/F= 16/15) with low trait anxiety and 37 (M /F= 18/19) with high trait anxiety. The two groups were significantly different in state anxiety ($F(1,63)= 58.72$; $p < .0001$, $\eta2 = .48$) and trait anxiety scores ($F(1,63)= 282.19$; $p < .0001$, $\eta2 = .82$). The difference between females and males in the state anxiety ($F(1,63)= 9.93$; $p < .001$, $\eta2 = .13$) and trait anxiety ($F(1,63)= 29.11$; $p < .0001$, $\eta2 = .31$) was significant (Table 1).

Table 1. Means, and standard errors (SE) of both State and Trait Anxiety scores in females and males with low and high trait Anxiety.

		State Anxiety		Trait Anxiety	
		Mean	SE	Mean	SE
Low Trait Anxiety	Female	39.06	1.82	36.06	1.01
	Male	33.83	1.66	30.93	0.97
High Trait Anxiety	Female	52.10	1.62	52.04	0.89
	Male	46.83	1.66	46.91	0.92

Instruments

The questionnaire is the same as the Emotional Stroop Task and the Dot-Probe Task.

Emotional Spatial Cueing Task

Apparatus and Stimuli are the same as the Emotional Stroop Task and the Dot-Probe Task.

Procedure

Participants were tested individually in a silent and dimly illuminated room, at a 50 cm distance from the computer screen. Each trial began with the presentation of a central cross of 1° (degrees of visual angle) for a duration of 500 ms. Two boxes (6 cm x 8 cm) were presented in the left or the right visual field, 5° from the fixation point. A cue was placed in one of the two boxes for 500 ms. After a fixed inter-stimulus interval (ISI) of

50 ms, the target, the letter "M" or "N" (Calibrì font 24) was presented, 0.9 ° x 0.9 ° either to the left or to the right. The target remains on the screen until the participant responds or up to 1500 ms. The cue was non-predictive (50% of valid trials and 50% of invalid trials). The sequence of the events for each trial is shown in figure 1.

The experiment consists of 320 trials for each cue type (pictures, faces and words). The order of presentation of the blocks was randomised. The participant's response was given by pressing the "A" or "L" key depending on the target. The pairing between target and key was balanced between subjects. Each block included a different cue type: words, pictures and faces. For each experimental one practice block of 15 trials was followed by 320 experimental trials.

General procedure

The participants were selected through public announcements. They signed the informed consent, and the Local Research Ethics Committee approved the study. First, the participants completed the STAI and then they underwent the Emotional Spatial Cueing Task.

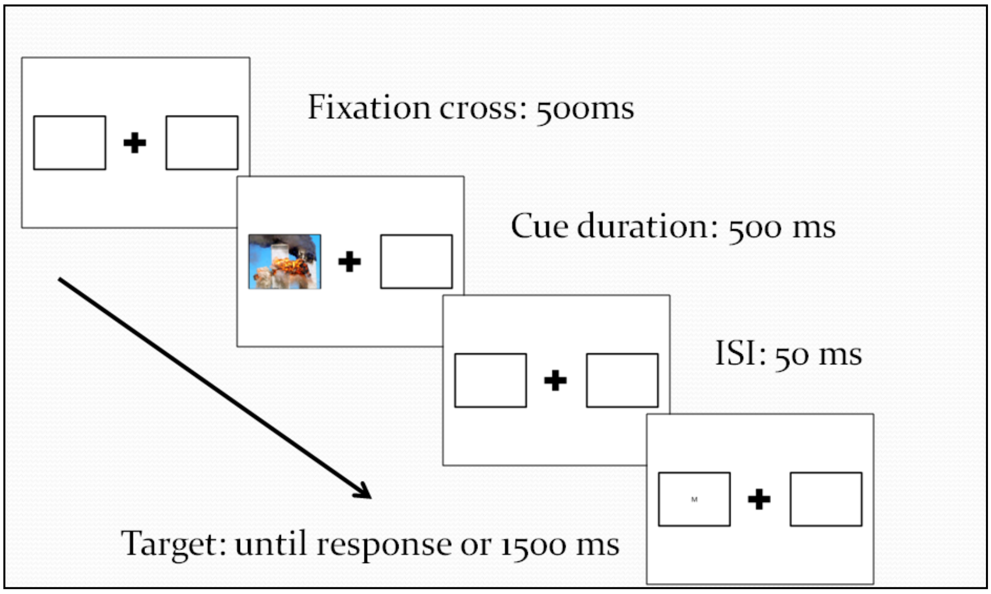


Figure 1. The experimental procedure in the Emotional Spatial Cueing.

Data analysis

Reaction times (RTs) and the percentage of correct responses were subject to 2 (Group: High trait Anxiety; HA); Low trait Anxiety; LA) x 2 (Gender: Females; Males) x 3 (Stimulus: Words, Pictures, Faces) x 2 (Validity: Valid; Invalid) x 2 (Emotion: Threat; Neutral) mixed-design ANOVA. According to Koster et al. (2006), attentional bias indexes were calculated. Positive scores in the index of attentional engagement (RTs neutral cue Valid – RTs threatening cue Valid trials) suggest facilitated engagement toward emotional stimuli. Negative scores are interpreted as a slower attentional engagement toward threatening stimuli. Contrary, positive scores in the index of attentional disengagement (RTs threatening cue Invalid – RTs neutral cue Invalid trials) reveal a difficulty in disengagement from emotional stimuli. Negative scores in the index of attentional disengagement indicate a rapid shift of attention away from negative stimuli.

A Group x Gender x Stimulus ANOVA was conducted on Engagement and Disengagement scores.

Planned comparisons analysed the effects and interactions. The significance level was established according to an α value of .05.

Results

Reaction times

The incorrect trials (5.4%) were removed from the analysis. According to Fox et al. (2002), RTs equal or briefer of 150 and equal or longer of 1200 ms were evaluated outliers. The RTs equal or briefer of 150 were considered as anticipatory responses, and the RTs equal or longer of 1200 were considered as delayed responses. Table 2 shows the means and standard errors of the RTs of each group for each experimental condition. The effects of Gender ($F(1,63)= 5.13$; $p = .02$, $\eta 2 = .08$), Stimulus ($F(2,13)= 4.94$; $p= .008$, $\eta 2 = .08$), Validity ($F(1,65) = 203.90$; $p <.0001$, $\eta 2 = .76$), and Emotion ($F(1,65)= 13.97$; $p= .0001$, $\eta 2 = .28$) were significant. RTs were faster in the females, compared to males (536.33 ms vs 563.98 ms). RTs were slower in the Pictures compared to both Words (558.73 ms vs 547.82 ms; $F(1,65)= 5.00$; $p = .03$; $\eta 2 = .03$)

and Faces (558.73 ms vs 543.90 ms; $F(1,65)= 7.09$; $p = .009$, $\eta2 = .10$). RTs were faster for Valid than Invalid trials (522.72 ms vs 577.58 ms) and for neutral stimuli compared to threatening stimuli (547.26 ms vs 553.04 ms). The Gender x Group interaction ($F(1,63)= 6.50$; $p = .01$, $\eta2 = .09$) revealed faster RTs in participants with low than high trait anxiety within the group of females (513.16 ms vs 559.49 ms; $F(1,63)= 7.08$; $p = .009$, $\eta2 = .10$). The Stimulus x Validity ($F(2,13)= 10.80$; $p < .0001$, $\eta2 = .14$) and the Stimulus x Emotion ($F(2,13) = 14.85$; $p < .0001$, $\eta2 = .19$) interactions were significant. In particular, RTs were slower in threatening trials when the stimulus is a Picture compared to Word (567.86 ms vs 546.77 ms; $F(1,63)= 12.49$; $p < .0001$, $\eta2 = .17$) and Faces (567.86 ms vs 544.50 ms; $F(1,63)= 14.24$; $p < .0001$, $\eta2 = .18$).

The Group x Stimulus x Validity x Emotion ($F(2,13) = 3.44$; $p = .03$, $\eta2 = .05$) interactions was also significant. To better understand this interaction, a Group x Validity x Emotion ANOVA was made for each type of stimulus.

For the Pictures, the effects of Validity ($F(1,65) = 100.06$; $p <.0001$, $\eta2 = .60$) and Emotion ($F(1,65)= 30.79$; $p < .0001$; $\eta2 = .32$) were significant. The Group x Validity x Emotion interaction ($F(1,65)= 3.23$; $p = .08$, $\eta2 = .05$) was marginally significant. For the Words, only the main effect of Validity was significant ($F(1,65) = 201.29$; $p <. 0001$, $\eta2 = .75$). For the Faces, the effect of the Validity ($F(1,65) = 125.09$; $p <. 0001$, $\eta2 = .66$) was significant and the Group x Validity x Emotion interaction was marginally significant ($F(1,65) = 3.39$; $p = .07$, $\eta2 = .05$).

Table 2. Means and standard error (SE) of RTs in males and females of the two groups of participants with high and low trait anxiety, for each experimental condition.

Stimuli	Validity	Emotion	Low Trait Anxiety		High Trait Anxiety	
			Female	Male	Female	Male
Pictures	Invalid	Threatening	551.33	610.62	603.87	604.51
			(18.03)	(17.45)	(16.46)	(16.46)
		Neutral	532.39	603.37	583.94	576.65
			(17.16)	(16.61)	(15.66)	(15.66)
	Valid	Threatening	507.01	564.95	551.20	549.40
			(17.37)	(16.82)	(15.86)	(15.86)
		Neutral	486.57	544.47	540.50	528.87
			(14.80)	(14.33)	(13.51)	(13.51)
Words	Invalid	Threatening	544.85	593.46	601.38	586.03
			(14.64)	(14.18)	(13.37)	(13.37)
		Neutral	544.68	596.51	600.25	583.48
			15.56	(15.06)	(14.20)	(14.20)
	Valid	Threatening	480.36	532.77	519.33	515.97
			(13.60)	(13.17)	(12.42)	(12.42)
		Neutral	477.68	539.74	520.25	528.47
			(12.70)	(12.30)	(11.60)	(11.60)
Faces	Invalid	Threatening	537.89	592.93	570.08	574.10
			(16.87)	(16.33)	(15.40)	(15.40)
		Neutral	528.03	597.10	568.60	575.84
			(15.02)	(14.55)	(13.71)	(13.72)
	Valid	Threatening	480.95	539.39	529.47	531.18
			(14.52)	(14.06)	(13.26)	(13.26)
		Neutral	486.27	547.96	525.04	517.68
			(15.08)	(14.60)	(13.76)	(13.76)

Engagement and disengagement indexes

Table 3 shows the means and standard errors of attentional engagement and disengagement in the groups of participants for each experimental condition.

Attentional engagement

A significant effect of Stimulus was significant (F(1,65) = 8.06; p < .0001, η2 = .12). In particular, the attentional engagement was lower in the Pictures compared to both Words (-17.17 ms vs 4.15 ms; F(1,65) = 13.41; p < .0001, η2 = .17) and Faces (-17.17 ms vs -0.95 ms; F(1,65) = 6.80; p = .01; η2 = .10). The Group x Stimulus interaction was marginally significant (F(1,65) = 2.43; p = .09; η2 = .04. To better analyse this interaction, separate ANOVA were carried out for each Stimulus.

A significant effect of Group (F(1,65) = 6.50; p = .01, η2 = .10) was present when the faces were used as stimuli. In particular, people with high trait anxiety present difficulty in the attentional engagement to threatening stimuli (Figure 2). No other effect was significant (F < 1).

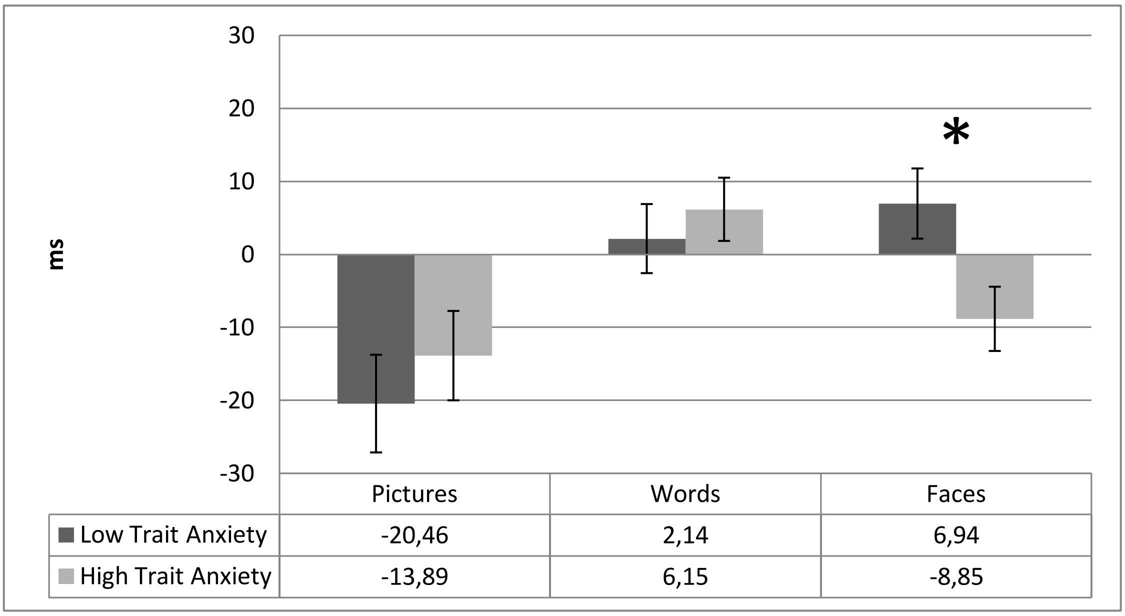


Figure 2. Means and standard errors of the attentional engagement index for each type of stimulus in the two groups with high and low trait anxiety.

Attentional disengagement

A significant effect of Stimulus was significant ($F(1,65) = 8.80$; $p < .0001$, $\eta2 = .12$), indicates higher attentional disengagement in the Pictures compared to both Words (18.64 ms vs -0.08 ms; $F(1,65) = 15.70$; $p < .0001$, $\eta2 = .20$) and Faces (18.64 ms vs 1.34 ms; $F(1,65) = 10.45$; $p < .001$, $\eta2 = .14$). To better analyse this interaction, separate ANOVA were carried out for each Stimulus and no main effect or interaction was significant ($F <2$).

Table 3. Means and standard errors (SE) of the engagement and disengagement scores for each type of stimulus in the males and females of the two groups with high and low trait anxiety.

Stimuli		Low Trait Anxiety		High Trait Anxiety	
		Female	Male	Female	Male
Engagement	Pictures	-20.44 (9.68)	-20.48 (9.37)	-10.70 (8.60)	-20.53 (8.84)
	Words	-2.69 (6.74)	6.97 (6.52)	-0.92 (5.99)	13.50 (6.15)
	Faces	5.31 (6.95)	8.57 (5.43)	-4.43 (6.18)	-13.50 (6.35)
Disengagement	Pictures	18.94 (7.47)	7.25 (7.23)	19.93 (6.63)	27.86 (6.82)
	Words	0.18 (5.79)	-3.04 (5.76)	1.13 (5.30)	2.55 (5.45)
	Faces	9.86 (8.93)	-4.17 (5.64)	1.48 (6.93)	-1.74 (5.15)

Accuracy

Table 4 shows the mean and standard errors of the percentage of correct responses of each participants' group, for each experimental condition.

The effects of Gender ($F(1,57)= 5,19$; $p= .03$; $\eta2= .08$) revealed response more accurate for Males compared to Females (0.957 vs 0.936). The effect of Validity (F(1,57)=

26.14; p< .0001; η2= .32) revealed response more accurate for Valid trials than Invalid trials (0.955 vs 0.938). The Gender x Group interaction (F(1,57)= 4.14; p< .05; η2= .07) was significant. In the group with low trait anxiety, males were more accurate than the females (F(1,57)= 8.83; p< .01; η2= .13; 0.967 vs 0.927).

The Group x Stimulus interaction (F (2,114)= 3.61; p= .03; η2= .06) was significant, and it shows response more accurate for faces than words in low trait anxiety individuals (F(1,57)= 12.54; p< .0001; η2= .18; 0.958 vs 0.938).

Table 4. Means (and Standard Error) of percentage of correct responses in the groups of participants for each experimental condition.

Stimuli	Validity	Emotion	Low Trait Anxiety		High Trait Anxiety	
			Female	Male	Female	Male
Pictures	Invalid	Threatening	0.918 (0.016)	0.976 (0.014)	0.934 (0.014)	0.929 (0.015)
		Neutral	0.903 (0.017)	0.960 (0.015)	0.936 (0.015)	0.933 (0.015)
	Valid	Threatening	0.942 (0.017)	0.965 (0.015)	0.952 (0.014)	0.943 (0.015)
		Neutral	0.928 (0.013)	0.976 (0.012)	0.956 (0.011)	0.947 (0.012)
Words	Invalid	Threatening	0.927 (0.016)	0.950 (0.014)	0.933 (0.014)	0.946 (0.015)
		Neutral	0.902 (0.016)	0.949 (0.014)	0.935 (0.014)	0.944 (0.015)
	Valid	Threatening	0.932 (0.014)	0.957 (0.013)	0.956 (0.012)	0.958 (0.013)
		Neutral	0.910 (0.014)	0.976 (0.013)	0.966 (0.012)	0.969 (0.013)
Faces	Invalid	Threatening	0.925 (0.016)	0.967 (0.014)	0.928 (0.014)	0.939 (0.015)
		Neutral	0.925 (0.014)	0.977 (0.012)	0.935 (0.012)	0.943 (0.013)
	Valid	Threatening	0.953 (0.010)	0.976 (0.009)	0.951 (0.009)	0.957 (0.009)
		Neutral	0.965 (0.011)	0.979 (0.010)	0.956 (0.009)	0.959 (0.010)

Discussion

In the present study, the attentional bias in people with high or low trait anxiety was assessed by considering the attention engagement or disengagement of attention to threatening stimuli in an Emotional Spatial Cueing paradigm. A difference between participants emerged in the attentional engagement index when the faces were used as cues. Specifically, people with high trait anxiety exhibit a negative score, compared to people with low trait anxiety. According to Koster et al. (2006), positive scores in the attentional engagement would suggest facilitation of attentional orienting toward the threatening stimuli. Conversely, negative scores would indicate a slower attentional engagement towards the threatening stimuli. Therefore, our findings suggest a slow engagement towards threatening stimuli in people with high trait anxiety, but only when the faces were used as cues.

The findings of the present study agree with the results observed in other studies (Broomfield and Turpin, 2005; Koster, Crombez, Verschuere, Van Damme and Wiersema, 2006). In particular, Koster and colleagues (2006) identified a slow attentional engagement (negative scores in the engagement score) in people with high trait anxiety with a short (200 ms) or long (500 ms) Stimulus-onset asynchrony (SOA). Broomfield and Turpin (2005) did not observe facilitation of attentional engagement (faster RTs in response to threatening stimuli) in the valid trials in the group of individuals with high trait-anxiety. However, there are some methodological differences between the experiments. While our results highlight the effect only in the experiment that uses faces as cues, Koster and colleagues (2006) observe the same pattern of response by using pictures selected by the IAPS.

In contrast, Broomfield and Turpin (2005) observed the same results, using words like cues. The experiments are also different in some characteristics of the Emotional Spatial Cueing. While in the present study the cue was non-predictive, the paradigm administered by Broomfield and Turpin (2005) was predictive, i.e. 2/3 of the trials were valid, and 1/3 of the trials were invalid. In the Koster et al.'s (2006) experiment, three types of emotional valence (15 pictures with high threat valence, 15 pictures with medium-threat valence, and 15 neutral pictures). A slow attentional engagement was observed for both types of threatening pictures. The presentation of a higher number of threatening stimuli than those (10 stimuli) used in the present study could have contributed to explaining the absence of results with picture stimuli. It could be hypothesised that exposure to numerous pictures with threat valence could have lead slower RTs in the engagement of attention.

The analysis of accuracy showed a higher number of correct responses in low trait anxiety males than low trait anxiety females. This result could be explained by the emotional content of the task. Indeed, the females tend to experience emotions more intensely (Bradley et al., 2001; Fernández-Berrocal et al., 2012; Deng et al., 2016) regardless of the level of anxiety. Consequently, an increased response to emotional stimuli could be lead to an increased number of errors.

The present study adds further information in the context of attentional bias, those about gender differences. The RTs were faster in the group of females with low trait anxiety, compared to the group of women with high trait anxiety. To explain this finding, we analysed the results obtained at the Attentional Control Scale (ACS, Derryberry and Reed, 2002). Interestingly, women with low trait anxiety show significantly less attentional control levels than women with high trait anxiety ($F(1.64) = 10.46$; $p < .001$; $\eta 2 = .14$; 53.65 vs 59.20). The fastest RTs displayed by not-anxious women could be depended on this low attentional control.

The current study is the first that analysed three types of stimuli in an Emotional Spatial Cueing paradigm in females and males with high and low trait anxiety. Further, differently from other studies (Wilson and MacLeod, 2003; Koster et al., 2004; Koster et al., 2006; Lee and Knight, 2009), this study has a strong point in the selection of participants who came from different disciplines (41.6% Psychology, 16.5% Economics, 16.5% Literature and Philosophy, 12% Law, 9% Medicine, 4.4% Engineering) and were not only psychology students. Usually, the studies in this field analyse only participants selected from the faculties of psychology. The selection of participant from different faculty could be a more representative sample.

It is well known that the detection of an emotional target involves attentional facilitation, as indicated by faster and more accurate responses in anxious individuals (Lang, Davis and Öhman, 2000; Mathews and Mackintosh, 1998; Mogg and Bradley, 1998). It could be interesting to verify if this facilitation in response to the target is also present in a Spatial Cueing Paradigm. Pérez-Duenas, Acosta and Lupiáñez (2009; 2014) have given a paradigm of Spatial Cueing (Posner, 1980), modifying the emotional valence of the target. Therefore, this test included a neutral peripheral cue and a target that could have neutral, positive or threatening valence. The results show that individuals with high trait-anxiety respond more quickly to words with negative valence, suggesting a more significant attentional capture (Pérez-Duenas, Acosta and Lupiáñez, 2009). Future perspectives could compare the stimuli (pictorial and lexical) by administering the paradigm of Emotional-Target Spatial Cueing, proposed by Pérez-Duenas and colleagues (2009, 2014).

The present study suggests some reflections for clinical practice and, specifically, for attentional orienting training in anxious individuals. It is important to point out that the cognitive avoidance of the threatening stimulus is a clear maintenance factor for anxiety disorders. In particular, a pattern of avoidance in the anxious individual does not allow to analyse information that could contribute to a more realistic and rational interpretation of the situation in which the person is involved (Mogg and Bradley, 1998; Williams et al., 1997). It would be relevant to investigate the mechanisms underlying cognitive avoidance and to develop different rehabilitation training for different categories of individuals with high trait-anxiety who have an attentional bias. It is indeed reasonable to hypothesise that an anxious individual who presents a difficulty in disengaging attention from the emotionally salient stimulus cannot carry out the same training of attentional re-orienting of the individual who exhibits cognitive avoidance from the threat.

CHAPTER 5

THE EMOTIONAL-TARGET SPATIAL CUEING TASK TO ASSESS THE ATTENTIONAL BIAS IN TRAIT ANXIETY PEOPLE: THE ROLE OF DIFFERENT TYPES OF STIMULI AND THE INFLUENCE OF GENDER

Abstract

Individuals with high trait-anxiety seem to present an attentional bias towards threatening stimuli. In particular, they tend to allocate attentional resources more quickly towards negative stimuli. The study aims to assess the attentional bias toward neutral and threatening stimuli (words and faces), used as the target, in females and males with high vs. low trait anxiety.

Fifty university students (M/F = 25/25) with high trait anxiety and 50 (M/F= 25/25) with low trait anxiety were selected according to the scores obtained in the STAI. The results showed a more rapid response to threatening faces compared to neutral faces in valid trials in the women with high trait anxiety. This finding suggests that women with high trait anxiety present an attentional bias toward biologically relevant stimuli. Results are discussed about studies on the attentional bias and clinical practice.

Keywords: Attentional Bias, Trait Anxiety, Emotion, Emotional-Target Spatial Cueing, Gender differences

Introduction

In recent years, there has been a growing interest in the attentional bias. Many cognitive theories have hypothesized in individuals with high trait-anxiety an excessive sensitivity towards the stimuli with a negative emotional valence (Beck and Clarke, 1997; Eysenck, 1992; Mathews, 1990; Mathews and MacLeod, 2002; Williams, Watt, MacLeod and Mathews, 1988; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, and van IJzendoorn, 2007).

For the evaluation of the attentional bias different paradigms and various stimuli have been used. In particular, among the most known paradigms the Emotional Stroop Task (MacLeod, 1991), the Dot-Probe Task (MacLeod, Mathews and Tata, 1986) and the Emotional Spatial Cueing Paradigm (Fox, Russo, Bowles and Dutton, 2001) were used. In the Emotional Stroop Task, the subject is required to determine the colour of a word or a picture that can have neutral or emotional valence. In the Dot-Probe Task, two images are presented simultaneously on the screen. The probe can be displayed either in the same position of the cue with negative emotional value (congruent condition) or in the same location of the cue with a neutral valence (incongruent condition). The subject has to respond to the probe. In the Emotional Spatial Cueing Paradigm, a person is required to discriminate or detect a target. The target is preceded by a peripheral cue (a stimulus with an emotional or neutral valence), which will be presented on the right or the left of the fixation cross. Afterwards, the target will appear in the cue position (valid condition) or the uncued position (invalid condition).

These experimental paradigms allow evaluating different indices of attentional bias. The Emotional Stroop Task has the function to assess the resolution of a conflict. Therefore, slower RTs in response to negative stimuli would indicate an attentional bias, as a slower response would suggest higher difficulty in resolving the conflict and attenuating the emotional stimulation (MacLeod, 1991). However, even a rapid response to the threatening stimulus could be interpreted as a rapid attentional engagement to the threatening stimulus (Clarke, MacLeod and Guastella, 2013). The Dot-Probe Task allows the calculation of the bias index, which enables the identification of two different types of attentional bias: the cognitive avoidance of the threatening stimulus, indicating by negative scores in the attentional bias index, and an excessive attentional engagement towards the threatening stimulus, revealed by positive scores in the attentional bias index (Fox, 2002). The Emotional Spatial Cueing Paradigm allows computing two indices of attentional bias. Attentional bias is present when the difference in reaction times (RTs) between neutral and threatening stimuli in the valid trials (the target stimulus is presented in the cue position) provides slower RTs, indicating a slow attentional engagement towards the threatening stimulus. The Attentional bias is also present when the difference in RTs between threatening and neutral stimuli in the invalid trials (the target stimulus is presented in an uncued position) indicates slower RTs, suggesting a difficulty in the disengagement of attention from the threatening stimulus (Koster et al., 2006). Precisely, the attentional bias can reflect a slow or a fast engagement towards the threatening stimulus or difficulty in disengagement of the attention from the negative stimulus. Only the Emotional spatial cueing allow to independently assessing the two types (engagement vs disengagement) of attentional bias.

Some authors, by using an Emotional Spatial Cueing Paradigm, have found difficulty in the disengagement from the threatening cue (Yiend and Mathews, 2001; Fox et al., 2002; Mogg et al., 2008; Sagliano et al., 2014); while other studies have observed a facilitation of attentional engagement to the threatening cue (Broomfield and Turpin, 2005; Massar et al., 2011; Azarian et al., 2016).

Therefore, the attentional bias should result in an abnormal response in the orienting of attention, and it would involve engagement, disengagement, and shifting of attention from the emotional cue to the target. However, few studies have analyzed the attentional orienting in individuals with high trait-anxiety when an emotional valence characterizes the target. Using a target with an emotional valence to evaluate attentional bias could be interesting if one considers that the detection of an emotional target involves a faster and more accurate response in anxious individuals (Lang, Davis and Öhman, 2000; Mathews and Mackintosh, 1998; Mogg and Bradley, 1998). The manipulation of the emotional valence of the target could indicate whether the target can catch the attention, enabling us to verify the attentional capture hypothesis (Pérez-Dueñas et al., 2009; Fox et al., 2002).

Pérez-Dueñas, Acosta and Lupiáñez (2009, 2014) have administered a paradigm of Emotional-Target Spatial Cueing, using as target words and faces with neutral, positive

or negative valence, while the cue was formed by a box that simulated a flash for 50 ms. The results obtained with the Emotional-Target Spatial Cueing paradigm indicated that the group of individuals with high trait-anxiety present slower RTs in invalid trials, compared to valid ones, for positive words. Also, individuals with high trait-anxiety showed a disappearance of the Inhibition of Return (IOR) for negative words. The authors interpret those as a higher attentional capture of words of negative valence (Pérez-Dueñas, Acosta and Lupiáñez, 2009). However, this result was not replicated when they used the faces as stimuli (Pérez-Dueñas, Acosta and Lupiáñez, 2014).
Another variable never considered by using this paradigm is the gender of the participants. Studies on the assessment of attentional bias in anxious individuals are conducted predominantly on females, than males. However, given the higher prevalence of anxiety in the woman's population (McLean et al., 2011), one could hypothesize gender differences about the attentional bias. Moreover, using the Emotional Stroop Task, it was highlighted a difficulty in resolving the conflict in the anxious males, compared to the anxious females (Boncompagni, chapter 2 of the present dissertation). With the Dot-Probe Task, anxious women, compared to anxious men, showed a pattern of avoidance of threatening stimuli (Boncompagni, chapter 3 of the present dissertation). Finally, with the Emotional Spatial Cueing, slower RTs were observed in the group of anxious women, compared to non-anxious women, regardless of the emotional valence of the cue (Boncompagni, chapter 4 of the present dissertation).

The present study aims to assess the attentional bias in people with high or low trait anxiety, by using two types of stimuli (words and faces) in a paradigm of Emotional-Target Spatial Cueing. According to previous studies (Pérez-Dueñas et al., 2009; Pérez-Dueñas et al., 2014), the attentional bias in anxious individuals should be indicated by a disappearance of the Inhibition of Return (IOR) effect in response to threatening targets, when the Stimulus Onset Asynchrony (SOA) is long (1000 ms). Moreover, it is hypothesized that this effect will be higher when a face rather than a word, is used as the target, considering the higher emotional relevance of this stimulus (Schacht and Sommer, 2009). The second aim of this study is to analyze gender differences in the attentional bias. Considering the higher sensitivity of females with high trait anxiety, compared to males, for threatening than neutral stimuli (Filkowski et al., 2017), it is hypothesized faster RTs in response to trials with a threatening target, compared to trials with a neutral target in women compared to men.

Method

Participants

One hundred and fifty university students were recruited at the "Sapienza" University of Rome. The participants are different from the students who participated in the Emotional Stroop Task, Dot-Probe Task, and Emotional Spatial Cueing Task. According to the 30th and 70th percentile indicated by the Italian validation of the State-Trait Anxiety Inventory-Form Y (STAI, Spielberger, 1983; Pedrabissi and Santinello, 1989), 50 participants (M/F= 25/25) with low trait anxiety and 50 (M/F= 25/25) with high trait anxiety were selected. The two groups were significantly different in state anxiety ($F(1,94)= 37.04$; $p< .0001$; $\eta2= .43$) and trait anxiety scores ($F(1,94)= 295.44$; $p< .0001$; $\eta2= .75$). The females and males were significantly different in both state anxiety ($F(1,94)= 12.90$; $p< .001$; $\eta2= .15$) and trait anxiety ($F(1,94)= 18.41$; $p< .0001$; $\eta2= .16$) (Table 1).

Table 1. Means, standard errors (SE) and ANOVA results of both State and Trait Anxiety scores in the Females and Males with low and high trait Anxiety.

		State Anxiety		Trait Anxiety	
		Mean	SE	Mean	SE
Low Trait Anxiety	Female	34.85	1.68	34.33	1.16
	Male	30.95	1.53	29.89	1.06
High Trait Anxiety	Female	48.14	2.08	53.99	1.44
	Male	39.28	1.77	45.00	1.28

Instruments

The questionnaire is the same as the Emotional Stroop Task, the Dot-Probe Task, and Emotional Spatial Cueing Paradigm.

Emotional-Target Spatial Cueing Task

Apparatus and Stimuli are the same as the Emotional Stroop Task, the Dot-Probe Task, and Emotional Spatial Cueing Paradigm.

Procedure

Participants were tested individually in a silent and dimly illuminated room, at a 50 cm distance from the computer screen. Each trial began with the presentation of a central cross of 1° (degrees of visual angle) for a duration of 500 ms. Two boxes (6 cm x 8 cm) were presented in the left or the right visual field, 5° from the fixation point. The cue was the flickering of the sides of one of the two boxes for 50 ms. The cue was non-predictive (50% of valid trials and 50% of invalid trials). After a variable inter-stimulus interval (ISI) of either 50 or 950 ms, the target, a word or a face, was presented. The target remained on the screen until the participant responded or up to 1900ms. The sequence of the events for each trial is shown in Figure 1.

The order of presentation of the blocks was balanced between subjects. Each block included a different target type: words and faces The participant’s response was given by pressing the "A" or "L" key depending on the emotional valence of the target. The pairing between target and key was balanced between subjects. For each experimental condition of faces and words, 320 experimental trials followed one practice block of 32 trials. The observations for each condition (SOA (Short SOA, Long SOA); Emotion (Threat, Neutral), Validity (Valid, Invalid)) were 40.

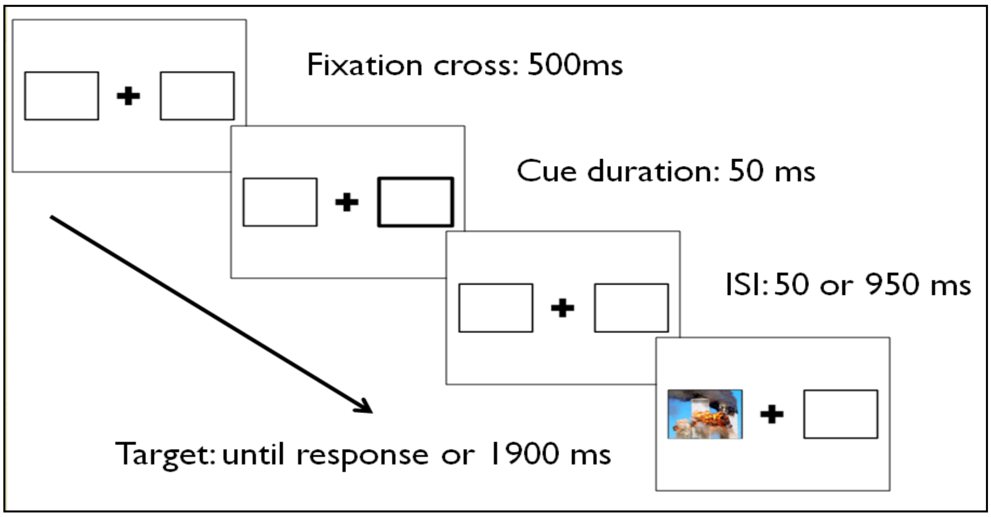


Figure 1. The experimental procedure in the Emotional-Target Spatial Cueing.

General procedure

The participants were selected through public announcements. They signed the informed consent, and the Local Research Ethics Committee approved the study. First, the participants completed the STAI and then they underwent the Emotional-Target Spatial Cueing Task.

Data analysis

The incorrect trials (9.5%) were removed from the analysis. According to (Keogh et al., 2001), RTs lower than 200 ms and higher than 1000 ms were excluded from the analysis. Statistical analyses were carried out on mean RTs of correct responses (90.5%) and mean percentage of correct responses.

RTs (or accuracy) were subject to 2 (Group: High trait Anxiety, HA); Low trait Anxiety, LA) x 2 (Gender: Females; Males) x 3 (Stimulus: Words, Faces) x 2 SOA (100 ms, 1000 ms) x 2 (Validity: Valid; Invalid) x 2 (Emotion: Threat; Neutral) ANOVA. Then a Group x Gender x SOA x Validity x Emotion ANOVA was separately performed for each type of stimulus. The attentional bias should be indicated by the disappearance of the IOR effect in response to threatening targets when the SOA lasted 1000 ms.

Planned comparisons analysed the interactions. The significance level was established according to an α value of .05.

Results

Reaction times

Table 2 shows the mean and standard errors of the RTs of each group for each experimental condition. The effects of Stimulus ($F(1,94)= 14.51$; $p< .001$; $\eta2= .13$), Validity ($F(1,94)= 90.10$; $p<.0001$; $\eta2=.49$), and SOA ($F(1,94)= 54.26$; $p< .0001$; $\eta2= .37$) were significant. RTs were faster when the stimuli were words than faces (670.29 ms vs 688.13 ms). RTs were faster for valid than invalid trials (672.90 ms vs 685.51 ms) and for the long than the brief SOA (673.40 ms vs 685.02 ms).The Stimulus x Emotion interaction ($F(1,94)= 32.49$; $p< .0001$; $\eta2= .26$) revealed faster RTs when the stimulus was a word than a face only when the targets have a neutral valence ($F(1,94)= 33.29$; $p< .0001$; $\eta2= .26$; 662.60 ms vs 692.31 ms; Figure 2). The Validity x SOA interaction ($F(1,94)= 5.79$; $p= .01$; $\eta2=.06$) was significant and it showed slower RTs in invalid trials than valid trials at the brief SOA (692.97 ms vs 677.06 ms; $F(1,94)= 86.13$; $p< .0001$; $\eta2=.48$) and at the long SOA (678.06 ms vs 668.75 ms; $F(1,94)= 19.94$; $p< .0001$; $\eta2=.18$).

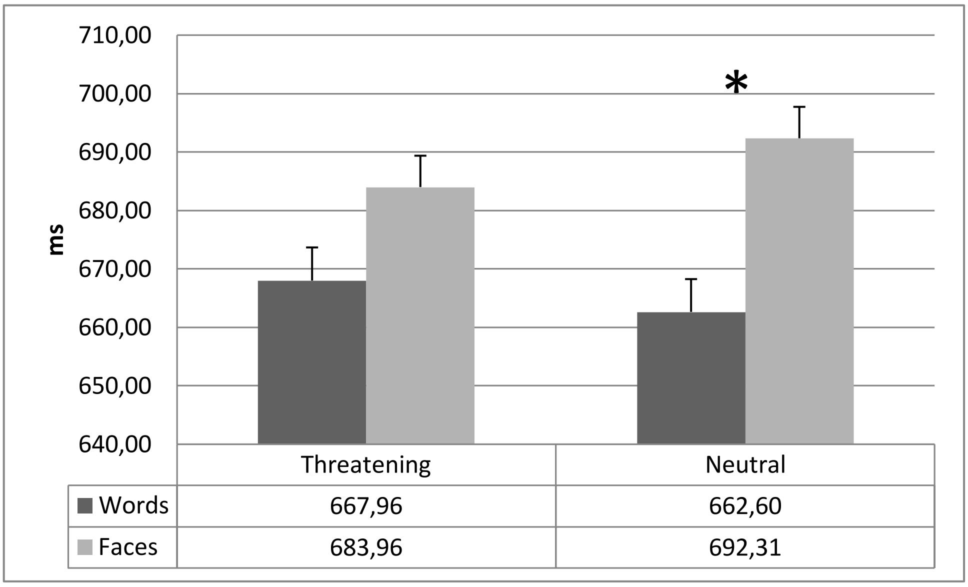


Figure 2. Means and standard errors for words and faces for each emotional valence of the target.

Table 2. Means (± SE) of RTs in the groups of participants for each experimental condition.

				Low Trait Anxiety		High Trait Anxiety	
				Female	Male	Female	Male
Words	Valid	Short SOA	Threatening	674.44 (12.05)	681.08 (11.80)	672.25 (12.05)	670.50 (11.80)
			Neutral	658.55 (11.18)	673.40 (10.95)	651.92 (11.18)	659.38 (10.96)
		Long SOA	Threatening	669.07 (11.88)	672.52 (11.64)	665.06 (11.88)	666.48 (11.64)
			Neutral	645.99 (12.36)	659.71 (12.11)	644.06 (12.37)	653.65 (12.11)
	Invalid	Short SOA	Threatening	697.67 (12.37)	693.02 (12.12)	684.29 (12.37)	687.58 (12.12)
			Neutral	675.94 (12.31)	693.33 (12.06)	671.34 (12.31)	675.62 (12.06)
		Long SOA	Threatening	676.89 (12.24)	684.44 (11.99)	676.26 (12.24)	675.84 (11.99)
			Neutral	657.94 (12.03)	661.47 (11.79)	659.90 (12.03)	659.53 (11.78)
Faces	Valid	Short SOA	Threatening	690.88 (11.44)	686.18 (11.21)	661.45 (11.44)	688.51 (11.21)
			Neutral	698.52 (11.27)	687.52 (11.04)	691.62 (11.27)	686.79 (11.04)
		Long SOA	Threatening	677.43 (11.71)	675.36 (11.48)	659.41 (11.71)	680.56 (11.47)
			Neutral	700.90 (12.23)	679.35 (11.98)	675.05 (12.23)	675.34 (11.98)
	Invalid	Short SOA	Threatening	700.33 (10.83)	708.30 (10.61)	687.03 (10.82)	696.20 (10.61)
			Neutral	710.23 (11.08)	700.74 (10.86)	699.78 (11.08)	706.12 (10.82)
		Long SOA	Threatening	686.60 (12.01)	684.29 (11.77)	668.17 (12.01)	692.56 (11.77)
			Neutral	704.15 (11.45)	685.36 (11.22)	685.23 (11.46)	690.31 (11.23)

Words

The ANOVA confirms the effects of Validity (F(1,96)= 67.51; p< .0001; η2= .42), SOA (F(1,96)= 37.32; p< .0001; η2= .27), and Emotion (F(1,96)= 25.22; p< .0001; η2= .21). The Validity x SOA interaction (F(1,96)= 5.10; p= .02; η2= .05) indicated a higher difference between invalid and valid trials when the SOA is short (685.22 ms vs 669.60 ms; F(1,96)= 69.60; p< .0001; η2= .42), than long (667.76 ms vs 659.85 ms; F(1,96)= 13.69; p< .0001; η2= .12). The SOA x Emotion (F(1,96)= 4.42; p= .03; η2= .04) interaction revealed slower RTs in the threatening trials, than neutral trials, when the SOA is short (683.36 ms vs 669.62 ms; F(1,96)= 14.42; p< .001; η2= .13), and when the SOA is long (674.56 ms vs 654.90 ms; F(1,96)= 29.73; p< .0001; η2= .24).

Faces

The ANOVA confirms the effects of Validity (F(1,94)= 57.11; p< .0001; η2= .38), SOA (F(1,94)= 35.83; p< .0001; η2= .27), and Emotion (F(1,94)= 4.85; p= .03; η2= .05). The Gender x Emotion interaction (F(1,94)= 4.19; p= .03; η2= .05) was significant and it revealed faster RTs in threatening trials, than neutral trials in the females (678.92 ms vs 695.69 ms; F(1,94)= 9.57; p< .01; η2= .09). The Group x SOA x Emotion (F(1,94)= 6.94; p< .01; η2= .07 and the Group x Gender x Validity x Emotion (F(1,94)= 4.18; p= .04; η2= .05) interactions were significant. To analyse these interactions a Gender x SOA x Validity x Emotion ANOVA was performed separately on each trait anxiety group.

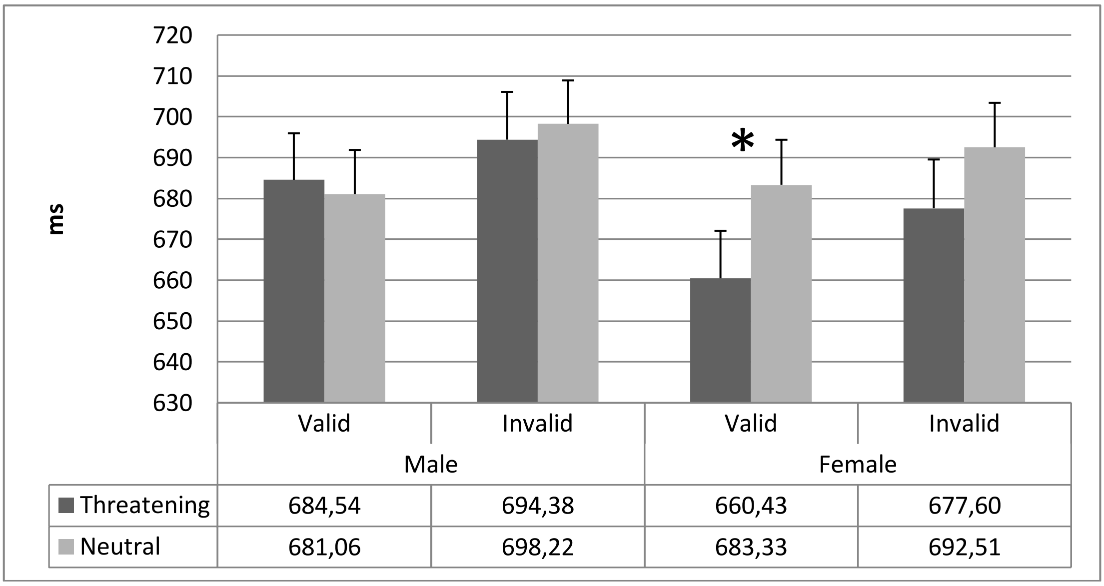
In people with high trait anxiety, the ANOVA confirmed the effects of Validity (F(1,47)= 42.52; p< .0001; η2= .47) and SOA (F(1,47)= 23.06; p< .0001; η2= .33). The effect of Emotion was marginally significant (F(1,47)= 3.58; p= .06; η2= .07). The Gender x Validity x Emotion (F(1,47)= 5.69; p= .02; η2= .11; Table 3) was significant. To better analyse this interaction, a Gender x Emotion ANOVA was performed separately on valid and invalid trials. In the valid trials, the Gender x Emotion interaction (F(1,47)= 4.98; p= .03; η2= .10) was significant and it revealed faster RTs in threatening trials than neutral trials in females (660.43 ms vs 683.33 ms; F(1,47)= 7.36;

p< .01; η2= .14). In the invalid trials, the effect of the Emotion (F(1,47)= 4.15; p< .05; η2= .08) showed faster RTs in threatening trials compared to neutral trials (685.99 ms vs 695.36 ms).

Table 3. Means (± SE) of RTs to threatening and neutral stimuli target of males and females with high or low trait anxiety for valid and invalid trials..

		Female	Male
Valid	Threatening	660.43 (11.64)	684.54 (11.41)
	Neutral	683.33 (11.02)	681.06 (10.80)
Invalid	Threatening	677.60 (11.92)	694.38 (11.68)
	Neutral	692.51 (10.88)	698.22 (10.66)

Figure 3. Mean and standard errors of RTs to threatening and neutral stimuli in valid and invalid trials in males and females with high trait anxiety.



In people with low anxiety, the effects of Validity ($F(1,48)= 19.11$; $p< .0001$; $\eta2= .29$) and SOA ($F(1,48)= 14.56$; $p< .0001$; $\eta2= .24$) were confirmed. The SOA x Emotion interaction was significant ($F(1,48)= 4.37$; $p< .05$; $\eta2= .09$) and it indicated faster RTs in response to threatening trials when the SOA was long than brief (680.92 ms vs 696.42 ms; $F(1,48)= 18.67$; $p< .0001$; $\eta2= .28$).

Accuracy

Table 4 shows the mean and standard errors of the percentage of correct responses of each participants' group, for each experimental condition.

The effects of Stimulus ($F(1,94)= 13.93$; $p< .0001$; $\eta2= .13$), and Emotion ($F(1,94)= 44.84$; $p< .0001$; $\eta2= .32$) were significant. The participants' responses were more accurate for word than faces (0.924 vs 0.886), and neutral than threatening target stimuli (0.937 vs 0.873). The Group x Gender ($F(1,94)= 4.02$; $p= .05$; $\eta2= .04$) interaction was significant and indicated more accurate responses in female with low trait anxiety compared to females with high trait anxiety (0.931 vs 0.885; $F(1,94)= 4.49$; $p= .04$; $\eta2= .05$).

Table 4. Means and standard errors of the percentage of correct responses for each group of participants in each experimental condition.

				Low Trait Anxiety		High Trait Anxiety	
				Female	Male	Female	Male
Words	Valid	Short SOA	Threatening	0.918 (0.020)	0.882 (0.020)	0.901 (0.020)	0.906 (0.020)
			Neutral	0.972 (0.012)	0.944 (0.012)	0.955 (0.012)	0.954 (0.012)
		Long SOA	Threatening	0.912 (0.021)	0.864 (0.021)	0.890 (0.021)	0.888 (0.021)
			Neutral	0.968 (0.011)	0.943 (0.011)	0.952 (0.011)	0.952 (0.012)
	Invalid	Short SOA	Threatening	0.917 (0.022)	0.880 (0.022)	0.888 (0.022)	0.909 (0.022)
			Neutral	0.966 (0.010)	0.938 (0.010)	0.955 (0.010)	0.954 (0.010)
		Long SOA	Threatening	0.916 (0.022)	0.866 (0.021)	0.890 (0.021)	0.903 (0.021)
			Neutral	0.970 (0.012)	0.950 (0.012)	0.946 (0.012)	0.942 (0.011)
Faces	Valid	Short SOA	Threatening	0.887 (0.029)	0.827 (0.029)	0.825 (0.029)	0.840 (0.029)
			Neutral	0.952 (0.027)	0.941 (0.027)	0.864 (0.027)	0.939 (0.027)
		Long SOA	Threatening	0.887 (0.027)	0.820 (0.027)	0.828 (0.027)	0.858 (0.027)
			Neutral	0.948 (0.029)	0.926 (0.028)	0.865 (0.029)	0.928 (0.028)
	Invalid	Short SOA	Threatening	0.897 (0.028)	0.840 (0.027)	0.840 (0.028)	0.853 (0.028)
			Neutral	0.942 (0.029)	0.930 (0.028)	0.860 (0.029)	0.948 (0.028)
		Long SOA	Threatening	0.888 (0.026)	0.834 (0.026)	0.829 (0.026)	0.854 (0.026)
			Neutral	0.959 (0.026)	0.939 (0.026)	0.877 (0.026)	0.931 (0.026)

Discussion

The main aim of the present study was to evaluate whether two different types of stimulus (words and faces) with threatening and neutral emotional valence in an Emotional-Target Spatial Cueing Paradigm can elicit an attentional bias in people with high trait anxiety. The secondary objective was the analysis of gender differences about the attentional bias in individuals with high trait-anxiety.

In the experiment using words as stimuli, no result suggests an attentional bias in people with high trait anxiety. The only relevant result confirms slower RTs in response to the invalid than valid trials and at the brief than long SOA (Wang and Klein, 2010). This response could be interpreted as reduced facilitation at the long than at the short SOA. However, there is no difference between people with high or low trait anxiety. These results contrast with those observed by Pérez-Dueñas, Acosta and Lupiáñez (2009), which found an IOR effect in people with high trait anxiety in response to positive words, but not in response to negative words. These inconsistent results could be depended on some methodological differences between the two studies. The stimuli used in the two experiments were different. While in the present study only negative and neutral words were used, in the Pérez-Dueñas et al.'s experiment positive stimuli were also included.

Furthermore, the authors did not report the results at the brief SOA. Secondly, the most significant difference concerns the task. In the present study, the target was presented until the response of the participants, while in Pérez-Dueñas et al.'s experiment the target was present for only 100 ms. The target duration is a factor influencing the appearance of the IOR effect (Chica et al., 2014). Indeed, it is observed facilitation when the target duration is until response, and when is absent a central flash (Martín-Arévalo et al., 2013). If a central flash is present, the IOR effect occurs, even if the target was displayed until the response (Martín-Arévalo et al., 2013). In the experiment that used faces as target stimuli, an attentional bias seem to be present in individuals with high trait-anxiety, but it appears to be modulated by participants' gender. Anxious females are faster in responding to the threatening target than the neutral target when the trials were valid. This result would confirm facilitation of the response to targets with threatening emotional valence in individuals with high trait-anxiety (Öhman, 2005, Öhman et al., 2001). Therefore, the present findings highlight an attentional bias in females and not in males. These results agree with recent evidence (Carlson et al., 2018), showing that women, but not men, present a higher bias score, i.e., an index of attentional bias (given by faster RTs on congruent trials, i.e. when the probe appears in the same location of the threatening stimulus in a Dot-probe task; Zvielli, Bernstein and Koster, 2015).

However, controversial results have been observed by using an Emotional Spatial Cueing (Koster et al., 2006). A higher cue validity index in males compared to females has been found for pictures evaluated as moderately threatening, compared to neutral pictures (Koster et al., 2006). This result would suggest a higher allocation of attention to threatening pictures in males and not in females, differently from the results of the present study. However, the Koster et al.'s experiment used an Emotional Spatial Cueing Paradigm, which is an emotional irrelevance task. In contrast, the present experiment is an emotional relevance task. Furthermore, in the present dissertation (Chapter 4) no gender differences in the attentional bias were found by using an Emotional Spatial Cueing.

Previous studies show an IOR effect for positive words in anxious individuals (Pérez-Dueñas et al., 2009) and an IOR effect for faces that expressed positive and neutral emotions, regardless of anxiety levels (Pérez-Dueñas et al., 2014). In the present study, no IOR effect was observed. One could hypothesise a process of habituation to negative and neutral stimuli, regardless of anxiety levels. According to Dukewich (2009), the habituation of orienting is based on some characteristic of stimulus and the repetitive presentation in a specific location.

In the present study, only negative and neutral emotions were considered; it may be opportune to replicate the experiment including also stimuli with positive emotional valence.

The analysis of the percentage of correct responses shows a more accurate response in women with low trait anxiety compared to the woman with high trait anxiety. This result confirms the results of the RTs. Indeed, the females with low trait anxiety indicate slower RTs than women with high trait anxiety (682.82 ms vs 672.05 ms). The lower accurate response in the females with high trait anxiety could reflect the excessive activation in response to emotional stimuli in individuals with trait anxiety (McLean and Anderson, 2009). The main limit of the study could be the number of participants. Although the number of participants is in line with that of previous studies (Pérez-Dueñas et al., 2009; Pérez-Dueñas et al., 2014), an increase in the number of participants would be desirable to obtain more robust results. Other limits could be not having considered also targets with a positive emotional valence and not having compared, with the same SOA and the same stimuli, directly the two experimental paradigms, i.e. Emotional Spatial Cueing and Emotional-Target Spatial Cueing. Finally, in the present study the trait anxiety levels were not as extreme as in the study of Pérez-Dueñas et al. Indeed, while in the present study the cut-off of the STAI involved the 30° and 70° percentile, in the Pérez-Dueñas et al. study the selection of the participants was based on 25° and 75° percentile.

However, the present study raises interesting results as regards the attentional bias and trait anxiety. First, a higher sensitivity of anxious individuals in response to faces is confirmed. These results agree with those observed with the classic Emotional Spatial Cueing Paradigm (Fox et al., 2002; Mogg et al., 2008; Massar et al., 2011; Azarian et al., 2016). Also, this study analysed gender differences, often neglected by the studies in this field of research. In fact, within participants with high trait anxiety, there was a higher responsivity of females, than males, in response to threatening faces. Future studies could compare Emotional Spatial Cueing and Emotional-Target Spatial Cueing. In particular, it would be useful to clarify whether an emotional-relevance task or an emotional-irrelevance task could be more sensitive for the evaluation of attentional bias. These future perspectives could contribute to the development of more effective training for the modification of attentional bias (ABM, Attentional Bias Modification, MacLeod et al., 2002), which, however, should take into account the gender of the participants.

GENERAL DISCUSSION

The present series of experiments was aimed to verify the attentional bias in individuals with high trait anxiety by considering the use of different experimental paradigms (Emotional Stroop Task, Dot-Probe Task, Emotional Spatial Cueing, Emotional-Target Spatial Cueing).

All the experimental paradigms considered would seem to confirm an attentional bias in people with high trait anxiety. Specifically, with the administration of the Emotional Stroop Task, the attentional bias manifests itself according to a pattern of avoidance and as difficulty in resolving the conflict. With the use of the Dot-Probe Task, the attentional bias is revealed by both avoidance of the threatening stimulus and a faster engagement of attention to the threatening stimulus. Finally, the Emotional-Target Spatial Cueing confirms a rapid attentional engagement to the threatening stimulus. Conversely, the Emotional Spatial Cueing revealed a slow engagement to the threatening stimuli. However, the Emotional Spatial Cueing is the only paradigm that would seem to show clear results regarding engagement and disengagement of attention. This task allows computing independently these two indices.

A second aim of the study was to verify whether a type of stimulus (pictures, faces, words) was more sensitive to catch the attentional bias. With the administration of the Emotional Stroop Task and the Dot-Probe Task, the results suggest an attentional bias associated with the pictures. In both the Emotional Spatial Cueing and the Emotional-Target Spatial Cueing, attentional bias was observed in response to faces. Therefore, the results would suggest a higher sensitivity of the pictorial stimuli, rather than the lexical ones. This higher sensitivity could be due to the higher emotional relevance of pictorial stimuli. In particular, the fast and automatic detection of human faces is well known (Hinojosa et al., 2015; Burrows, 2008, Hadj-Bouziane et al., 2008).

Furthermore, many pictures included scenes representing people could have led to higher attention towards these stimuli. It could be hypothesised that the participant's attention could have been captured quickly and automatically by the faces represented in the scenes. Conversely, words are learned stimuli and express a meaning on a symbolic level (Fruhholz et al., 2011). This factor could result in less emotional relevance, which would affect the assessment of a complex phenomenon such as attentional bias.

Another aim of the present study was to clarify whether the attentional bias in individuals with high trait-anxiety can change according to the gender of the participants. All experimental paradigms would seem to confirm the presence of attentional bias, especially in women with high trait anxiety. Only the Emotional Stroop Task would appear to highlight an attentional bias in males with high trait anxiety, which is reflected by difficulty in resolving the conflict. However, interestingly, the woman with high trait anxiety did not exhibit the Stroop interference. This result could be interpreted as an avoidance of the threatening stimuli: women with high trait anxiety would respond more quickly to trials with a threatening target, to pass to the next trial. Therefore, it could be hypothesised that the attentional bias manifests itself according to two different patterns in females and in males with high trait anxiety: while men would present a difficulty in resolving the conflict, the women would exhibit a pattern of avoidance of the threatening stimuli.

Even with the Dot-Probe Task, the attentional bias presents two opposite patterns for males and females. While woman appears to avoid the threatening stimuli, men show a rapid attentional engagement towards the emotionally negative stimuli. With the Emotional-Target Spatial Cueing, the attentional bias would seem to be a quicker response to threatening faces in anxious females.

Only the Emotional Spatial Cueing did not allow to gender differences in the attentional bias. There is a more rapid response of non-anxious women, compared to anxious women, regardless of the stimuli valence or the stimuli selection.

The number of participants could represent the main limit of the research. Although the number of participants in each experiment overlaps with that of the other studies on attentional bias, an increase in experimental subjects could lead to more reliable results. Other limits could be not having also considered stimuli with a positive emotional valence and not having compared the different experimental paradigms.

A second limitation of the research could be identified in the data analysis. Indeed, the present dissertation was not carried out the Bonferroni correction. However, in this field, no studies have applied this adjustment. If had been performed the Bonferroni correction, probably many studies would not have highlighted significant results.

In conclusion, despite all the experimental paradigms show an attentional bias in high trait anxiety, for the study of the attentional bias the Emotional Spatial Cueing would seem to lead to more precise results. It is the only experimental paradigm that allows evaluating attentional engagement and disengagement.

The results obtained from these four experiments do not allow clarifying whether the attentional bias manifests itself as a facilitation of the engagement or as a difficulty of disengagement. It could be suggested that the attentional bias can manifest itself according to different attentional processes (for example, cognitive avoidance, rapid attentional engagement to the threatening stimuli, difficulty in the disengagement from the threatening stimuli). This hypothesis could have numerous implications in clinical research in this area. In particular, recent studies are adopting attitudinal re-orienting training through Attentional Bias Modification (ABM; MacLeod et al., 2002). According to the authors (MacLeod et al., 2002), individuals with high trait-anxiety, if placed in front of a threatening stimulus and a neutral stimulus, would direct attention automatically towards the threatening stimulus. Therefore, a Dot-Probe Task is experimentally modified with the aim to re-orienting attention. Especially, the participants belonging to the experimental group are trained to respond to 75% of the time to a probe that will appear in the same location as the neutral cue. However, it could be assumed that different typologies of training could need. For example, the ABM procedure may not affect the attentional bias when it manifests itself as cognitive avoidance. The main limitation of the ABM procedure is the promotion of a pattern of cognitive avoidance of the threatening stimuli. However, cognitive avoidance of negative stimuli is a maintenance factor for anxiety disorders. In conclusion, it could be hypothesised that such treatment may not have direct benefits on long-term anxiety disorder, as it does not directly affect anxiety disorder, but only on a component of attentional orienting.

Further studies on the ABM training are necessary to increase the knowledge on this field and to allow to correct clinical applications.

Finally, it is necessary to underline that all the paradigms considered in this study do not evaluate the same process. This could contribute to the explanation of the different processes underlying the attentional bias highlighted in this dissertation. One could hypothesise the administration of a paradigm that combines the evaluation of both the orienting system and the executive system. A test that allows evaluating at the same time the attentional networks (Alerting, Orienting and Executive) is the Attentional Network Test for Interaction (ANTI, Callejas et al., 2004). This task is a combination of the Spatial Cueing Paradigm (Posner, 1980) and the Flanker Task (Eriksen and Eriksen, 1974). The ANTI requires participants to discriminate faster and most accurate possible if the central arrow (the target) points to the right or left, ignoring the side arrows (the flankers). Before the presentation of the target and flankers, a cue is presented. The ANTI includes three cue conditions: valid, invalid and no-cue. The flanker conditions can instead be of two types: congruent (the flankers point in the same direction as the target) or incongruent (the flankers point in the opposite direction to the target). The Alerting effect is evaluated by presenting a tone, in half of the trials. The Orienting effect is calculated by subtracting the RTs of the valid cue from the RTs of the invalid cue. The Conflict effect is calculated through the subtraction of the RTs of the flanker congruent condition from the RTs of the incongruent flanker condition. To analyse the conflict resolution of emotional stimuli, the target and flanker stimuli could be replaced by stimuli with negative or neutral emotional valence (Attentional Network Test for Interaction - Emotion, ANTI-E; Boncompagni & Casagrande, 2019). The ANTI-E could permit to assess at the same time attentional orienting and conflict resolution, and it could clarify some cognitive processes subtended the attentional bias in anxious individuals.

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