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Efectos de la ansiedad estado-rasgo sobre la atención selectiva a estímulos amenazantes en una muestra no clínica de niños escolarizados

Research

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ABSTRACT

Attentional biases, consisting of a preferential processing of threatening stimuli, have been found in anxious adults as predicted by several cognitive models. However, studies with non-clinical samples of children have provided mixed results. Therefore, the aim of this research was to determine the effects of state and trait anxiety on the selective attention towards threatening stimuli in a non-clinical sample of school children (age: 8 to 13, n = 110) using the dot-probe task. This study did not reveal an effect of trait anxiety on selective attention towards threatening stimuli. However, a significant difference was found between participants with low state anxiety and high state anxiety. Nevertheless, the effect size was small. Specifically, participants with low state anxiety showed a bias towards threatening stimuli. Overall, the findings of this research with a non-clinical sample of school children suggest that attentional biases towards threatening information, which has been repeatedly found in anxious adults, are not necessarily inherent to non-clinical anxiety in children and on the other hand, the relationship between attentional biases and anxiety in this population might be moderated by other cognitive processes.

RESUMEN

Los sesgos atencionales, que consisten en el procesamiento preferencial de los estímulos amenazantes, han sido encontrados en adultos con ansiedad tal como predicen varios modelos cognitivos. Sin embargo, los estudios con muestras no clínicas de niños han arrojado resultados inconsistentes. Por consiguiente el objetivo de esta investigación consistió en determinar los efectos de la ansiedad estado-rasgo sobre la atención selectiva a estímulos amenazantes en una muestra no clínica de niños escolarizados entre los 8 y 13 años (n = 110), utilizando la tarea dot-probe. Este estudio no reveló un efecto de la ansiedad rasgo sobre la atención selectiva hacia los estímulos amenazantes. Sin embargo, se observó una diferencia significativa entre los participantes con ansiedad estado baja y ansiedad estado alta aunque el tamaño del efecto fue pequeño. Específicamente, los participantes con ansiedad estado baja mostraron un sesgo hacia los estímulos amenazantes. En general, los hallazgos de esta investigación con una muestra no clínica de niños escolarizados sugieren que los sesgos atencionales hacia la amenaza, que han sido encontrados reiteradamente en los adultos ansiosos, no necesariamente son inherentes a la ansiedad no clínica en los

Palabras clave: sesgos atencionales, tarea dot-probe, ansiedad rasgo, ansiedad estado, muestra no clínica, niños escolarizados.

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niños y por otro lado la relación entre los sesgos atencionales y la ansiedad en esta población podría estar mediada por otros procesos cognitivos.

1. INTRODUCTION

The objective of the present research consisted of determining the effects of state and trait anxiety on selective attention towards threatening stimuli in a non-clinical sample of school children. The dot-probe task was used to measure the attentional bias towards threat. This computerized task, which was used based on previous studies (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg y Van IJzendoorn, 2007), used images of angry faces as threatening stimuli. Participants were to indicate, by means of the keyboard, the orientation of an arrow that appeared some place on the screen previously occupied by an angry or neutral face. The presence of attentional biases towards threatening stimuli is determined by analyzing the reaction times of the individual in different types of trials. If the individual presents a selective attentional bias towards threat, the reaction times will be shorter in the trials where the arrow substituted the threatening stimulus (congruent trial) in comparison to the reaction times in those trials where the arrow substituted the neutral stimulus (incongruent trial) (Cisler y Koster, 2010).

Neuropsychology and cognitive psychology studies that have used the dot-probe task, point out that selective attention to threatening stimuli, phenomenon which has been called attentional bias towards threat, is involved in the etiology and/or maintenance of anxiety (Bar-Haim, 2010; Hakamata et al., 2010) and has been defined as the tendency to attend threatening stimuli simultaneously present with neutral stimuli (Cisler y Koster, 2010; Schrooten, 2007); nevertheless, most of these studies have been carried out in adults

(Bar-Haim et al. 2007); on the contrary, research studies on infant population have showed divergent results.

The study of attentional biases on children is highly relevant, for in Colombia, anxiety disorders show the highest prevalence among mental illnesses and it is estimated that the age of onset varies between 6 and 24 years of age (Ministerio de la Protección Social, 2003). Besides starting at an early age, the vital cycle of these disorders can be chronic and progressive throughout adulthood. On the other hand, the chronic exposure to stressful situations at early stages of life can alter attentional processes generating biases that, in turn, contribute to the etiology or maintenance of anxiety (Bishop, 2007). In regards to this, the epigenetic studies carried out with animals and humans have shown that adverse circumstances can modify the expression of genes (Szyf, 2009) changing, as a result, the development and activity of neuronal systems that underlie behavior (Curley, Jensen, Mashoodh, Champagne, 2011), which can increase vulnerability to anxiety disorders (Bredy, Sun y Kobor, 2010).

Concerning this, Colombia's Mental Health Study in 2003 reported a prevalence of mental disorders in children and adolescents of 9,4% out of which, anxiety disorders, was one of the main causes of consultation (Ministerio de la Protección Social, 2003). Additionally, research on neurocognitive functions such as attention and its interaction with emotional phenomena, provides a promising framework to study the factors that contribute to the development and chronicity of anxiety (Shechner et al., 2011) and to apply this knowledge to the design of effective neuropsychological interventions. For instance, a study conducted with children, ages between 8 and 14 years old, showed that the Attention Bias Modification Treatment (ABMT) based on the dot-probe task, reduces the symptoms and severity of pediatric anxiety (Eldar, Apter, Lotan, Perez Edgar, Naim, Fox, Pine y Bar-Haim, 2012).

There is optimism in the pragmatic value of studies on attentional biases towards threat that could be translated into a higher comprehension of the mechanisms implied in anxiety, and better yet, on the clinical practices that are rooted in a strong experimental cognitive science and evidence given by neuroscience. Within the coming years a growing number of clinical trials will help establish the efficacy of attention training protocols and to determine whether these could be used as an independent treatment or as part of the existing treatments.

1.1 State and trait anxiety and its relation to attentional biases towards threat.

In the study of attentional biases towards threat in non-clinical population, trait anxiety refers to a personality characteristic that predisposes an individual to perceive a wide range of objectively inoffensive circumstances as threatening and to respond to these circumstances with a level of state-anxiety that is disproportionate in relation to the extent of the danger (Spielberger, 1966; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983).

On the other hand, state anxiety, refers to a temporary emotional state characterized by subjectively perceived feelings of tension, apprehension and increase of activity of the autonomic nervous system (Spielberger, 1966; Spielberger et al., 1983).

According to the cognitive models of attentional bias, anxiety influences the components of attention generating the preferential processing of the threatening stimuli (Cisler & Koster, 2010) although it has been also found that the induction of attentional biases can cause anxiety (Eldar, Ricon & Bar-Haim, 2008; MacLeod, Rutherford, Campbell, Ebsworthy & Holker, 2002). Posner & Petersen (1990) state that the components of visual attention are shifting, engaging and disengaging. The shifting component allows directing one's attention to a spatial location and the engaging facilitates the stimulus processing by superior systems. By means of the disengaging component, the attention is disconnected from the current focus before being directed to a new focus. (Castillo & Paternina, 2006). The first two operations have been related to vigilance bias towards threat while the third operation has been related to a difficulty to move one's attention away from the threatening stimulus (Koster, Crombez, Verschuere, Van Damme & Wiersema, 2006).

Some cognitive models state that the threatening stimulus direct or capture the attention of anxious people (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Öhman, 2008; Wells & Mathews, 1994; Williams, Watts, MacLeod & Mathews, 1988) while other models propose that these individuals have difficulty to disengage the attention from such stimuli (Bar-Haim et al., 2007; Clark & Beck, 2010; Eysenck & Derakshan, 2011; Eysenck, Derakshan, Santos & Calvo, 2007). By using the dot-probe paradigm, it was found that the attentional bias towards threat in adults is caused by a deficit in the disengaging component. Similarly, Salemink, Van den Hout & Kindt (2007) reported that people with high trait anxiety presented a difficulty to disengage the attention from threatening stimuli. The studies that have been carried out with children by using the dot-probe paradigm have not deepened on the components of attentional bias (Legerstee et al., 2009; Puliafico & Kendall, 2006), but they have used a global index to determine whether it is a vigilance or avoidance bias (Reinholdt-Dunne et al., 2011; Susa et al., 2008; Telzer et al., 2008; Waters et al., 2004).

Other studies report an effect of suppression of attentional bias towards threat in stressful conditions (Amir et al., 1996; Constans et al., 2004; Helfinstein, White, Bar-Haim & Fox, 2008; Kindt et al., 1997b; Mathews & Sebastian, 1993). Williams, Mathews & MacLeod (1996) suggest that the anxiety experienced in stressful situations leads participants to increase their efforts in the task, which allows them to compensate the effect of the interference in the emotional Stroop.

The emotional Stroop task, different from the dot-probe task, does not discriminate the components of visual attention and consists of participants naming the colors in which some words are shown at the same time they try to ignore their content, which can be neutral or threatening (Eschenbeck, Kohlmann, Heim-Dreger, Koller & Leser, 2004). Alternatively, Mathews & Sebastian (1993) point out that stressors produce a change in the processing priorities in such a way that an imminent threat inhibits the attention to other distractors. Evidence related to the increased effort hypothesis can be obtained by using the dot-probe and emotional Stroop tasks. If the participants exposed to a stressful situation increase their efforts in the attentional task, a faster response must be evidenced in the neutral trials in comparison to the participants that have not been exposed to the same condition (Constans et al., 2004).

Although numerous research studies have established the presence of attentional biases towards threat in people with anxiety disorders or high state-trait anxiety (Bar-Haim et al., 2007), most studies have been conducted with adults while the ones conducted with children show inconsistent results. Bar-Haim et al., (2007) meta-analysis revealed "a relative paucity in studies of threat-related bias in anxious and nonanxious children". Besides, they point out that this type of research has a clear theoretical and practical relevance due to the high prevalence of anxiety in adolescents and children and the continuance of trait anxiety in adulthood.

On the other hand, there is ambiguity in terms of the type of anxiety that relates to attentional biases. In non-clinical populations the evidence obtained by means of different experimental tasks suggests that attentional biases are related to state anxiety (Carretié, Mercado, Hinojosa, Martín-Loeches & Sotillo, 2004; Dennis, Chen & McCandliss, 2008; Dresler, Mériau, Heekeren & Van der Meer, 2009; Fox, Russo, Bowles & Dutton, 2001; Mogg, Bradley, De Bono & Painter, 1997), trait anxiety (Fox, 2002; Richards, French, Johnson, Naparstek & Williams, 1992; Richards, Hadwin, Benson, Wenger & Donnelly, 2011) and to the interaction between state and trait anxiety (MacLeod & Mathews, 1988). Particularly Mogg, Mathews, Bird & Macgregor-Morris' 1990 study, did not find any relation between selective attention towards threatening stimuli and state-trait anxiety, but it did establish that when facing severe stress, selective attention affects equally people with low trait anxiety and high trait anxiety. In contrast, Derryberry & Reed (2002) propose that trait anxiety interacts with attentional control to produce attentional biases. There is no clarity on this matter in the case of children since research on the relation between state-trait anxiety and attentional biases has been scarce on this population in comparison to research conducted with adults (Hadwin & Field, 2010).

As for infant population the attentional biases have mainly been studied on children with anxiety disorders and with samples that were not selected based on self anxiety reports while the impact of state-trait anxiety on the biases of selective attention have been studied at a lower scale on this population with inconsistent results (Hadwin & Field, 2010). On samples not selected based on self-reports of anxiety the state anxiety and the attentional bias towards threat have been correlated (Williams et al., 1997, en Garner, 2010).

On the contrary, Telzer, Mogg, Bradley, Mai, Ernst, Pine & Monk, (2008) found that the attentional bias towards angry faces manifests itself in children with high trait anxiety. Reinholdt-Dunne, Mogg, Esbjorn & Bradley (2011) point out that the demonstration of attentional bias in children does not depend only on the level of trait anxiety, but also on age, proving that younger and moderately anxious children present attentional bias towards angry faces while other studies have reported that attentional bias towards threatening information is common to all children (Eschenbeck et al., 2004; Kindt, Bierman & Brosschot, 1997a; Susa, Pitica & Benga, 2008; Waters, Lipp & Spence, 2004).

Furthermore, it has been reported that the generalized presence of attentional biases in children could be associated to the weakness in the inhibitory control which is common in a developing nervous system (Susa, et al., 2008). However, Lonigan & Vasey (2009) found that children with a high level of negative affectivity and low level of attentional control showed attentional bias towards threatening words. On the other hand, Kindt, Brosschot & Everaerd (1997b) reported evidence of suppression of attentional bias in stressful situations using the emotional Stroop in a non-clinical sample of children aged between 8 and 9 years old. Researchers found that all children prioritize the processing of the threatening information; however, this bias disappears when the presence of a stressor is imminent.

The results of these studies point out that the presence of attentional biases towards threat in children could be associated to trait anxiety, state anxiety or the weakness of inhibitory control. Yet, on the other hand, the study by Kindt et al., (1997b) and studies with adults (Amir et al., 2006; Constans, McCloskey, Vasterling, Brailey & Mathews, 2004) suggest that attentional bias towards threat could disappear in the real or imminent presence of a stressor.

Likewise, there are theoretical discrepancies that require a broader empirical look.

The different cognitive models on attentional bias have focused on the individual differences in trait anxiety. However, predictions can extrapolate to clinical population keeping in mind that trait anxiety is a risk factor to develop pathological anxiety (Miu, Heilman & Miclea, 2009; McNaughton, 2002). These models differ in regards to the effects that anxiety will have on selective attention of threatening stimuli.

1.2 Measurement of selective attention bias towards threat.

Cisler and Koster (2010) claim that the observation of attentional bias in different experimental tasks is important, for it suggests that this phenomenon is not an artifact generated by specific procedures. Among the paradigms that have been used to study attentional bias towards threat are the emotional Stroop, the dot-probe task, the visual search task and exogenous signals.

In the dot-probe task, originally created by MacLeod et al., (1986) two stimuli are shown on a computer screen that can be words or images. The stimuli disappear after a brief exposure and an asterisk or another element appears in the place previously occupied by them. The participant is asked to press a button indicating the location of the asterisk. The attentional bias is inferred from the reaction time in trials where the asterisk replaces the word or threatening image (congruent trial) compared to the reaction time in trials where the asterisk replaces the word or neutral image (incongruent trial)

If the individual presents a selective attention bias towards threat, the reaction time will be shorter in trials where the asterisk replaces threatening stimuli. However, if the participant presents an avoidance bias of threat, the reaction time will be shorter in trials where the asterisk replaces neutral stimuli. In a variation of this task, the subject must press the button corresponding to the type of stimulus presented instead of indicating its position. This variation reduces the probability that the individual skews his/her attention to a particular location, yet due to its complexity, this can generate a larger amount of errors in data (Mogg & Bradley, 1998).

To differentiate between the components of orientation and difficulty for disengaging the attention, reaction times during congruent and incongruent trials must be compared to reaction times in trials where neutral stimuli appear (Koster et al., 2004; Salemink et al., 2007). Fast reaction times in congruent trials in comparison to neutral trials is interpreted as a vigilance bias while slow responses in incongruent trials in comparison to neutral trials is interpreted as a difficulty to disengage attention. Several studies demonstrate the presence of attentional biases through the dot-probe task (p.ej., Bar-Haim et al., 2007; Koster et al., 2004; Pérez-Edgar, Reeb-Sutherland et al, 2011; Waters et al., 2004).

The versions of the dot-probe task used with children employ picture stimuli instead of verbal stimuli since the differences relating to age in the conceptual

skills and those of reading could decrease the capacity of words to capture attention. For this reason, the most used designs with infant population employ picture faces due to their intrinsic capacity to convey emotions (Shechner et al., 2011).

Although some limitations have been pointed out in regards to the psychometric properties of tasks such as emotional Stroop and dot-probe (Cisler, Bacon & Williams, 2007; Rislov, 2009), Bar-Haim et al., (2007) assert that attentional bias towards threat has been demonstrated in a reliable manner using those instruments.

1.3 Neuroanatomical correlates of attentional bias towards threat in anxiety.

The study of the neuronal circuits has been mainly carried out on primates due to the difficulties inherent to the neuroanatomical research with humans. This approach has allowed identifying subcortical and cortical structures implied in spatial attention (Shipp, 2004).

At a subcortical level, the superior colliculus and the pulvinar nucleus of the thalamus are important centers of this function (Vecera & Rizzo, 2003). At a cortical level

the main centers for the control of sight are the frontal and parietal eye fields. In sum, spatial attention implies the joined action of structures involved in the visuomotor actions and those of visual recognition (Shipp, 2004), which allows for the automatic or volunteer orientation towards environment's stimuli.

With respect to attention towards dangerous or threatening stimuli, the studies through neuroimaging indicate that a prefrontal cortex amygdala circuit underlies this process and this also suggests that this circuit's activity is altered in people with anxiety creating a bias towards potentially threatening stimuli (Bishop, Duncan & Lawrence, 2004; Bishop, 2007). It has been established that this bias is implied in the maintenance and/or etiology of anxiety (Bishop, 2008).

Initial evidence suggests that anxiety is correlated to a hyperactivity of the amygdala and a deficient recruitment of the prefrontal cortex (Bishop, 2007). The amygdala is involved in the recognition of danger signals and the control of autonomous and behavioral responses to threat. Besides, studies that use positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) have found that the amygdala preferentially responds to faces and scenes. The study of non-human primates has revealed that the amygdala sends feedback projections towards visual areas and these connections could act in parallel with descendent attentional processes to increase transiently the perceptual processing of emotional stimuli (McHugo, 2010). Finally, the amygdala influences attention not only through its anatomic projections towards sensory areas, but also through its projections towards cortical regions implicated in the orientation and attentional control and subcortical structures involved in the arousal modulation (McHugo, 2010).

On the other hand, the prefrontal cortex adjusts the amygdala's activity once danger has been overcome or the stimulus valence has changed (Spampinato, Wood, De Simone & Grafman, 2009). Within this contextual frame the anxiety can generate biases in selective attention by increasing the danger signal detected by the amygdala and/or reducing the control signal of the prefrontal cortex.

It has been debated whether, in fact the amygdala responds automatically when facing threat, and it has been found that this structure activates in the presence of stimuli that are not consciously attended; however, other findings indicate that this is only observed when the cognitive demands of the task carried out by the individual are low, and thus, it is possible to attend other stimuli simultaneously. On the other hand, when the task carried out by the individual is demanding and it requires higher attention, the amygdala's response when facing distracting stimuli is reduced (Bishop, 2007).

The amygdala's activation to subliminally presented stimuli has been considered as evidence of the automatic response to the threat through a fast route thalamus-amygdala.

While the conscious perception of a visual stimulus implies the reverberation of the activity between occipital-temporal and frontoparietal areas, the subliminal processing occurs when the activity triggered by the stimulus is too weak to generate that reverberation and, instead, it is processed at a subcortical level (Bishop, 2008). Nevertheless, the amygdala's activation in response to a masked stimulus not necessarily proves the functioning of a subcortical thalamus-amygdala route. Regarding this, a study that registered the amygdala's intracranial activity, found that this structure responds to the subliminal presentation of emotional words 800 ms after the exposure; this latency is higher to the one expected for an automatic response and it suggests that a faint trail has previously reached the cortical regions required for the semantic processing of stimuli (Naccache et al, 2005).

The data reported by Bishop (2009) suggest that trait anxiety correlates to a poor recruitment of the prefrontal cortex in conditions of low perceptual load and the absence of threat. In contrast, high trait anxiety has been associated with an increase of the amygdala's response to threatening distracting stimuli. The origin of the alteration in the prefrontal control mechanisms in anxiety continues to be an interest of

study, yet the evidence indicates that the exposure to stress can have long term effects that result in the amygdala and the prefrontal cortex's dysfunction (Bishop, 2008).

2. METHOD

This is an experimental study with a 2 x 2 factorial design (state anxiety: low and high; trait anxiety: low and high) the dependent variable corresponds to the attentional bias index.

2.1 Participants

Children were recruited from two schools in the city of Barranquilla, who obtained informed consent from their parents to participate in the study. Inclusion criteria: The children that reported low and high levels of trait anxiety were selected through the State-Trait Anxiety Inventory validated for Colombian children between 8 and 15 years old (Castrillón y Borrero, 2005).

Exclusion Criteria: Children who showed uncorrected vision, intellectual problems, learning difficulties or psychiatric disorders as reported by their parents, were not chosen. Finally, the sample was conformed by 110 boys (51 girls and 59 boys) between 8 and 13 years old (M = 10.15, DE = 0.89).

2.2 Instruments

State-Trait Anxiety Inventory (STAIC): the STAIC (which in Spanish stands for, Questionario de Ansiedad Estado/Rasgo en Niños), validated for Colombian children whose ages range from 8 to 15 years old by Castrillón and Borrero (2005), consists of an 18-item scale. The analysis of this instrument's structure showed that trait anxiety is composed by four factors: 1. Worry, 2. Avoidance, 3. Somatization, 4. Rage and Sadness while the state anxiety is composed by two factors: 1. Fear, and 2. Calm. The STAIC standardization was carried out with a 670 sample of children from both genders in 35 public and private institutions from Medellín (Castrillón y Borrero, 2005). The reliability level of the instrument as indicated by the alpha of Cronbach is 0.6.

Dot –probe Task: The cognitive task was programmed by means of Inquisit Millisecond 3.0.4.0 software, following reported specifications in previous studies (Eldar et al., 2008; Eldar et al., 2012; Susa et al., 2008).

- Task version: Target stimulus classification.
- Target stimulus specifications: a 2 cm high by 1 cm wide arrow was used, which can be pointing up or down.
- Neutral and threatening stimulus specifications: The stimuli consisted of pictures of 16 actors' faces (8 male and 8 female) taken from NimStim Set of Facial Expressions (Tottenham et al., 2009). Two pictures from each actor were selected; one showing an expression of anger and the other showing a neutral expression. The pictures' dimension is 253 x 325 pixels. The faces were shown in an equidistant manner to the left and the right from the fixation cross, located in the center of screen. Each critical trial in the task presents the angry and neutral face of the same actor, which allows both stimuli to coincide in multiple perceptual characteristics, which only differ in the emotional valence.

Heart Rate Monitor: As an instrument to obtain the variability measurements from the heart rate (HRV or Heart Rate Variability), a Polar RS800cx monitor was used and it was programmed to register a speed of intervals sampling R-R and whose data were later set in a PC program.

2.3 Procedure

According to STAIC scores in the trait anxiety factors, the sample was divided in two groups. Participants with percent scores ranging from 1 to 15 in the factors that measured the trait anxiety in STAIC formed the low trait anxiety group (n = 56). The participants with percent scores from 75 to 100 in one or more of the factors that measured trait anxiety in the STAIC formed the high trait anxiety (n = 54). For the purpose of separating the effects of the trait anxiety and the state anxiety the Mogg, Mathews, Bird y Macgregro-Morris, (1990) procedure was used, from which each trait anxiety group was randomly assigned to conditions of low state anxiety or high state anxiety. The experiment was carried out with every participant individually in a quiet room. Initially, the monitor's heart rate band was placed around the participant's chest.

Then, the intervention to manipulate the emotional state was carried out to separate the effects of state anxiety and trait anxiety. Diverse procedures have been applied for the manipulation of children's emotional state (Brenner, 2000). For this study, the Success/Failure False Feedback procedure was implemented, which has been applied in children, ages between 9 and 12 years old. This method consists of giving children false feedback on their performance to make them believe that they have failed or have succeeded (Brenner, 2000; Gerrards-Hesse, Spies & Hesse, 1994).

Some of the used tasks include drawings, anagrams, labyrinths, and bowling. What is expected from this procedure, is that it generates a positive or negative emotional state if a success or failure feedback has been given respectively. The similarity of this method to the Learned Helplessness Procedures

carried out in adults, suggests that the Success/Failure False Feedback can induce anxiety in children. The measurement of the effect can be done by means of questionnaires and analog visual scales (Brenner, 2000).

The task employed in the Success/Failure False Feedback procedure consisted of solving block design problems. The participants assigned to the low state anxiety condition were given several simple designs during six minutes. At the end they were given positive feedback on their performance. The participants assigned to the high state anxiety condition had a time limit to solve every design problem. They were told that they would be recorded as they carried out the task. At the end of the activity, they were given a negative feedback on their performance.

After the Success/Failure False Feedback procedure, the participant was asked to answer the state anxiety items from the STAIC. Then s(he) carried out the dot-probe task and at the same time the heart rate variability measurements were obtained by means of the

Polar RS800cx equipment since this physiological indicator relates to anxiety (Appelhans & Loecken, 2006; Berntson & Cacioppo, 2004) and with induced stress by mental activities (Boonnithi & Phongsuphap, 2011; Choi & Gutiérrez-Osuna, 2009; Taelman, Vandeput, Spaepen & Van Huffel, 2009). Particularly, the low frequency/high frequency index (LF/HF) of the heart rate variability reflects the equilibrium between the sympathetic and parasympathetic systems, being higher in conditions of anxiety (Petrowski, Herold, Joraschky, Mück-Weymann & Siepmann, 2010).

The dot-probe task was shown in a laptop with a 14-inch screen. It consisted of 20 practice trials and 96 experimental trials that were presented in random order for each participant. For the practice tests, neutral images from the International Affective Picture System – IAPS (Lang, Bradley & Cuthbert, 2005) were used. As shown in picture 1, every trial starts with the presentation of a fixation cross in the center of the screen, followed by the presentation of two faces for 700 ms. Then, the target stimulus appears and the participants must determine the arrow orientation by pressing one of the two pre-established keys on the keyboard. A new trial will start after 1400 ms have passed following the appearance of target stimulus. The task presents three types of trials. In the congruent trial, the target stimulus appears in the location previously occupied by the threatening stimulus. In the incongruent trial, the target stimulus appears in the location previously occupied by the neutral stimulus. In the neutral trial, the valence of both stimuli is neutral and the target stimulus can appear to the right or the left.

Figure 1.*Sequence of dot-probe task events.*

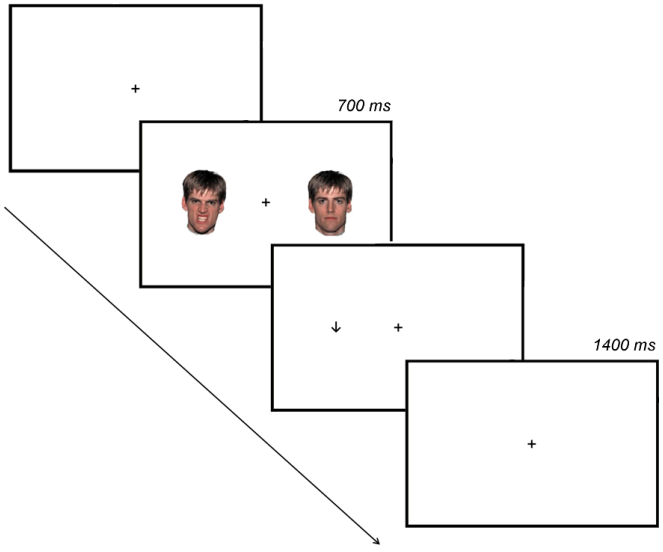
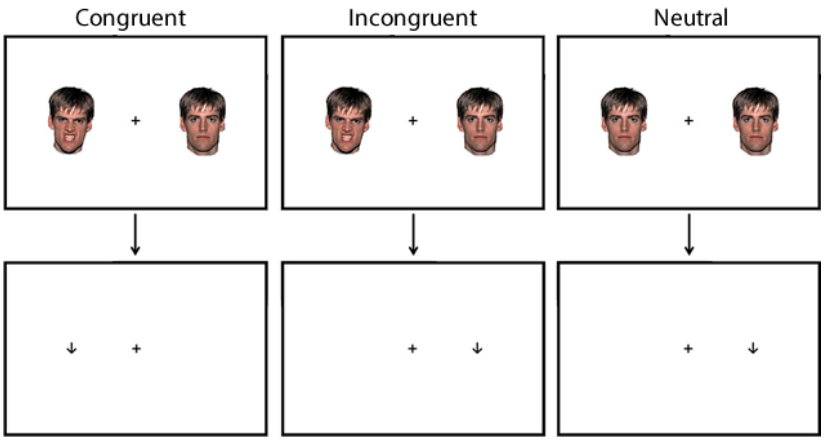


Figure 2. *Types of trials in the dot-probe task*



The experiment ended with a debriefing procedure in which the researcher explained the real nature of the activities carried out and solved the participant's concerns.

Finally, the following analysis plan was developed: The data was entered in the

IBM SPSS Statistics 22 program. In order to compare the scores obtained by each group in the scales and the dot-probe task, preliminary analysis of normality and homoscedasticity were done. Based on this, the adequate statistics were used to determine the effects of state anxiety and trait anxiety on the selective attention of threatening stimuli with .05. alpha level.

2.4 Ethical considerations

The researchers obtained written consent from the educational institutions' directors to invite the students and parents to participate on this study.

The parents received an invitation letter along with the informed consent and a questionnaire designed to obtain information about the presence of children with un-corrected vision issues, anxiety disorders or any other type of clinical diagnosis. The latter is in accordance with 1090 law from 2006 in chapter VII (Colegio Colombiano de Psicólogos, 2009) regarding scientific research.

As for the emotional state manipulation used in this study, Brenner (2000) points out that there are three ethical considerations in the administering of this type of procedures in children: the informed consent, the emotional state intensity and the debriefing. Regarding to the emotional state intensity and in accordance with the terms in Resolution 8430 of 1993, the procedures carried out in this study represented a reasonable experience for the participant and comparable to those inherent to their present medical, psychological, social or educational condition. After the manipulation of the emotional state, a debriefing procedure was conducted aiming at informing the participants as to the nature of this research and solve their concerns about the study.

3. RESULTS

3.1 STAIC Results for the trait anxiety

In order to analyze the STAIC scores, the Mann-Whitney U test was used given that data was not normally distributed. The results indicate a significant difference between the low trait anxiety group and the high trait anxiety for each of the trait anxiety factors, being higher the scores of the high trait anxiety.

3.2 Manipulation of the emotional state

The Mann-Whitney U test was used to compare the STAIC scores obtained on each state anxiety factor. A significant difference was found between the low state anxiety group and the high state anxiety group where the participants belonging to the high state anxiety group reported a higher level of fear and a lower level of calm in comparison to the low state anxiety group.

Regarding the measurement of the state anxiety at a physiological level, a marginally significant difference was observed between the low state anxiety group and the high state anxiety being higher the LF/HF index in the high state anxiety group.

Table 1. *Differences between the low trait anxiety group and the high trait anxiety group for each trait anxiety factor.*

	Trait anxiety	Average Range	Mann-Whitney U	*P*
Worry	Low	40.30	661	< .001
	High	71.26		
Avoidance	Low	35.76	406.5	< .001
	High	75.97		
Somatization	Low	43.41	835	< .001
	High	68.04		
Rage and Sadness	Low	43.20	823	< .001
	High	68.26		

Table 2. *Difference between the low state anxiety group and the high state anxiety group for each state anxiety factor.*

	State Anxiety	Average Range	Mann-Whitney U	*P*
Fear	Low	45.84	981	.001
	High	65.16		
Calm	Low	66.92	884.5	< .001
	High	44.08		

Table 3. *Differences between the low state anxiety group and the high state anxiety group in the LF/HF index*

	State Anxiety	Average Range	Mann-Whitney U	*P*
LF/HF	Low	47.02	1076	.05
	High	58.44		

3.3 Selective attention bias

In line with previous studies (Reinholdt-Dunne et al., 2011; Waters et al., 2004;) reaction times in the trials that contained incorrect answers and were to 3 or more standard deviations under or over the average were excluded from the analysis (3.5% from the total of the data).

The (ABI) or attentional bias index was calculated from the following formula used in previous studies (Bradley, Mogg, Millar, Bonham-Carter, Fergusson, Jenkins & Parr, 1997; Dalgleish, Moradi, Taghavi, Neshat-Doost & Yule, 2001; Dalgleish, Taghavi, Neshat-Doost, Moradi, Canterbury & Yule, 2003; Helzer, Connor-Smith & Reed, 2009; Lonigan & Vasey, 2009; Mansell, Clark, Ehlers & Chen, 1999):

[(RS/LT – RS/RT) + (LS/RT – LS/LT)]/2

On this formula, the L and R letters indicate the position (left and right) of the target stimulus (S) and that of the threat (T). For instance, the RS/LT expression corresponds to the average in the reaction times of the incongruent trials where the target stimulus appears to the right (RS) and the threat appears to the left (LT). As it can be observed, the average of the congruent trials is subtracted from the average of the incongruent trials. A positive ABI indicates a vigilance bias, but if it is negative, it indicates an avoidance bias. The ABI value is equal to zero when there is no presence of attentional biases.

The ANOVA 2 x 2 of the ABI with state anxiety and trait anxiety as intersubject variables showed that the main effect of trait anxiety over the attentional bias was not significant: $F(1, 106) = 0.11$, $p = .73$, indicating that the trait anxiety had no effect over the attentional bias over the threatening stimuli. On the other hand, a main effect of state anxiety was found, which indicates a significant difference between the low state anxiety and the high state anxiety; however, the size of the

effect is considered small: F(1, 106) = 4.18, p = 0.04, η2 partial = .04. The interaction effect between state anxiety and trait anxiety was not significant: F(1, 106) = 1.25, p = .26.

Table 4. *Attentional bias index (ABI) per group.*

State	Trait	M	S.D
Low	Low	8.68	32
	High	16.67	33
	Total	12.6	32.45
High	Low	3.58	27.61
	High	-0.71	20.99
	Total	7.03	29.14

Because a main effect of trait anxiety or an interaction effect between state anxiety and trait anxiety were not found, the presence of attentional biases for both levels of state anxiety was studied. Therefore, a t test was conducted to contrast whether the ABI average of every group significantly differs from zero, in which case there is indication of attentional biases. The results indicate that the participants in the low state anxiety present an attentional bias towards threat: t(54) = 2.88, p = 0.006; on the contrary, the participants in the high state anxiety condition, did not show bias towards threat: t(54) = 0.44, p = .65.

Additionally, reaction times in the neutral trials between both conditions of state anxiety were compared for the purpose of determining whether the absence of attentional bias towards threat in the participants of the high state anxiety condition resulted from an increased effort in the dot-probe task, which would be reflected in the faster answers of this group. Nonetheless, no significant differences were found in the speed of answers in the neutral trials: F = 0.03, p = .85.

3.4 Selective attention components

Aiming at identifying the visual attention component responsible for the attentional bias towards threat, orientation and disengagement indexes were calculated. The orientation index was calculated by subtracting the average reaction times on the congruent trials from the average reaction times of the neutral trials:

3.4.1Orientation Index = tN,N – tT,N,

Where tN,N represents the neutral trials and the tT,N represents the congruent trials. A positive result in the orientation index indicates faster answers in the congruent trials than in the neutral trials. The disengagement index was calculated by subtracting the

3.4.2 average reaction times of the neutral trials from the average reaction times of the incongruent trials:

Disengagement index = tN,T – tN,N,

Where tN,T represents the incongruent trials. A positive result in the disengagement index indicates slower responses in the incongruent trials than in the neutral trials.

The comparison of the orientation index values to zero, showed that the participants in the low state anxiety condition shifted attention towards the threatening stimuli t(54) = 2.15, p = .036. No evidence was found of the difficulty to disengage the threatening stimuli attention: t(54) = .28, p = .77.

4. DISCUSSION

The present study examined the effects of state-trait anxiety on selective attention to threatening stimuli in a non-clinical sample of school children.

In order to separate the trait anxiety and state anxiety effects, the Success/Failure False Feedback procedure was implemented. The levels of state anxiety examined through STAIC and the LF/HF index were significantly higher in the high state anxiety group in comparison to the low sate anxiety group, indicating that the manipulation of the emotional state was effective.

The findings show that there was not an interaction effect between trait anxiety and state anxiety. In line with what was reported in previous studies (Eschenbeck et al., 2004; Susa et al., 2008) the study evidenced that trait anxiety had no effect on the selective attention towards threatening stimuli. Because state anxiety relates to the activation of the fear system, which responds to threatening stimuli that have biological relevance such as angry faces (Fox et al., 2001), this study hypothesized that state anxiety would have effect on the selective attention towards threat. Although the difference between the groups of low state anxiety and high state anxiety was significant, the size of the effect was small. According to Bar-Haim et al., (2007) meta-analysis, the attentional bias towards threat is a robust phenomenon although the size of the effect is moderate. In clinical and non-clinical

samples on adults, the difference between anxious and not anxious participants is significant and the size of the effect is moderate.

Conversely, in the case of children only a significant difference with a moderate effect size was observed in the clinical samples. Nonetheless, it is necessary to note that the results correspond to studies that did not manipulate the state anxiety and did not examine the interaction between trait anxiety and state anxiety. A small size effect could indicate that the attentional bias towards threat is not inherent to non-clinical anxiety (Kindt et al., 1997a; Waters et al., 2004). But could also be explained by the interaction of anxiety with other variables such as attentional control.

Yet, it could also be explained by the interaction of anxiety with other variables such as attentional control. Evidence in favor of this explanation was provided by Derryberry & Reed (2002) who found that anxious adults with a poor attentional control showed an attentional bias towards threat while those with a good attentional control were capable of deviating their attention from the threat.

Similarly, Lonigan & Vasey (2009) found that only children with low levels of attentional control and high levels of affective negativity showed an attentional bias towards threatening stimuli. In other words, these studies suggest that anxiety by itself does not explain attentional biases towards threat in non-clinical samples, but interaction between anxiety (in this case trait anxiety) and attentional control does. It is important to find out in future research whether state anxiety plays any role in this interaction.

Besides, this research allowed detecting the presence of attentional biases in the low state anxiety group, which evidenced an effect of orientation towards threatening stimuli while no attentional biases were found in the high state anxiety group. This finding is consistent with previous studies that have reported an effect of suppression of the attentional bias towards threat in high state anxiety conditions (Amir et al., 1996; Constans, 2004; Helfinstein et al., 2008; Kindt et al., 1997b; Mathews & Sebastian, 1993).

Constans et al., (2004) propose that the location of the temporal stressor can influence the appearance or suppression of the attentional bias in such a way that the exposure to a stressful situation prior the attentional task causes bias towards threat while the expectation of being exposed to the stressor after the task generates effects of suppression of the bias. Nonetheless, Helfinstein et al., (2008) found that the suppression of the bias towards threatening stimuli can also be manifest due to the transitory presence of stressors during the dot-probe task. On the present study, the participants in the high state condition were exposed to the stressor before the dot-probe task; however, they were informed that they would have a final evaluation after carrying out the task, which favors the anticipatory anxiety.

The suppression of the attentional bias can be explained by an increase in the effort to carry out a certain task or by a prioritization of an imminent threat. The increased effort hypothesis states that under certain circumstances (e.g., a stressing situation) the participants increase their efforts in the task, and thus, they are capable of reducing or completely suppressing the activation of threatening representations (Mathew & Mackintosh, 1998; Williams et al., 1996). On the other hand, the prioritization hypothesis indicates that in a situation where multiple threatening stimuli are presented, major attentional resources are automatically assigned to the event that represents the strongest threat inhibiting the bias towards less threatening stimuli (Mathews & Sebastian, 1993).

In relation to the increased effort hypothesis, the attentional control mechanism could be the underlying factor to suppression of bias towards threat. According to Eysenck et al., (2007) model, anxiety weakens attentional control although under certain conditions anxious individuals can inhibit this tendency through the recruitment of a larger amount of cognitive resources and a bigger effort to maintain a good performance during the task (Berggren, Koster & Derakshan, 2012). Evidence in favor of the increased effort hypothesis would implicate that reaction times in the neutral trials would be lower in the high state anxiety condition in comparison to the low state anxiety condition (Constans et al., 2004).

No significant differences in the reaction times during neutral trials were found among participants from both experimental conditions; thus, results do not favor this hypothesis. Probably the absence of attentional bias in the group of high state anxiety is product of the prioritization of the imminent stressor, which in turn inhibits the attention towards other threatening representations. However, it is also possible that the difference in reaction times of neutral trials is a poor indicator of the cognitive effort and consequently, the increased effort hypothesis continues to be a feasible explanation (Constans et al., 2004).

This research had the following limitations: The state anxiety measurement was taken after the Success/Failure False Feedback procedure just as in Moog, Mathews, Bird & Macgregor-Morris, (1990) study in which the state anxiety was measured after having manipulated this variable through a stressful situation. Yet, the significant difference found on this study between the low state anxiety and the high state anxiety after the Success/Failure False Feedback procedure does not exclude a significant difference before the procedure.

On the other hand, no robust data have been reported on the psychometric properties of the dot-probe task although according to Bar-Haim et al. (2007) meta-analysis, the attentional bias towards threat has been demonstrated in a reliable manner by using this instrument. Additionally, cross-sectional studies provide limited information regarding the effects of age and previous learning in the relation between anxiety and attention. Therefore, longitudinal studies that allow determining the effect of learning and attention on the development of children's anxiety are required (Shechner et al. 2011).

To sum up, this study's findings suggest that attentional biases towards threat, which have been repeatedly found in non-clinical adult samples, were observed in the non-clinical sample of schoolchildren but they are not necessarily inherent to a high level of anxiety. Possibly, the emergence of attentional biases on children is associated to the capacity during development for inhibiting irrelevant information and not exclusively to high anxiety states, which is coherent with the presence of attentional biases in the low state anxiety group. Evidence in both, adults and children, point at a link between the anxiety and the attentional control in the processing of threatening information (Derryberry & Reed, 2002; Lonigan & Vasey, 2008); In spite of this, such studies focus on the trait anxiety. It is necessary to study in a longitudinal manner the progression of biases towards threat with a focus on anxiety and attentional control.

Additionally, an interesting subject of study would consist of analyzing the effect of transitory and prolonged state anxiety and of the attentional control on attentional biases because if well it is true that a stressful temporary condition can suppress the attentional bias, it is possible that in the long run, it could have contrary effect acting to the detriment of the cerebral structures that are involved in emotional regulation and attention control.

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