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SCOPE OF ATTENTION VARIATION AS A FUNCTION OF ANXIETY AND DEPRESSION

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SCOPE OF ATTENTION VARIATION AS A FUNCTION OF ANXIETY AND DEPRESSION

A Thesis

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by

Kathleen Anne O'Donnell

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ABSTRACT

As a social species, correct emotional perception is so vital, that the human brain has evolved a mechanism to control attentional choices by exerting a narrowed field of perception during danger, called the scope of attention (SoA). The SoA determines what information will be focused on or ignored by blocking the perception of non-relevant items and increasing selective focus on danger; even if danger is merely a sad-face. The emotional items blocked from perception cannot be remembered because they were never perceived. But, attention-control to emotional stimuli also varies with mood, as seen in mood-disorders. A mood-disorder's effect upon the SoA has not been extensively studied, and no investigations examining the SoA in mood-disorders versus healthy individuals could be found in the literature. Thus, this thesis considers the question: Do mood disorders affect the SoA during emotional interactions? To investigate this, we evaluated individual differences in the SoA for those with or without mood-disorder symptomology, during visual processing of emotionally-salient stimuli. We measured the responses to emotionally-salient distracting faces near to, and far from, the target face. Results indicated that the state anxiety group identified target emotions more slowly than did healthy individuals. In addition, those with state anxiety had a comparable SoA to healthy individuals, except while viewing a sad target with sad, far away distractors. This negative environment broadened the state groups SOA, instead of narrowing it. Thus, the state anxiety group perceived an overabundance of negative emotional content

from the surrounding faces. Depression and trait anxiety groups SoAs were comparable to healthy controls during sad targets, but not happy. The scope of attention for those with depression and trait anxiety narrowed when the target was a happy face and the distracting faces were in close proximity to the target. Thus, the depression and trait anxiety groups did not perceive the emotional content of the surrounding faces. These results suggest that state anxiolytics are relatively slower in responding to emotional information in a facial stimulus, but once they identify the face as happy at close range, they achieve the same, broad, scope of attention as healthy individuals. However, state anxiolytics are particularly affected when negative emotional items are experienced with, distant, negative surrounding emotions. By contrast, once depressives and trait anxiolytics identify a positive emotional expression, they are restricted in their ability to recognize contrasting or changing expressions in individuals who are in close proximity to their focus of attention. Therefore, individuals with high trait anxiety or depression have a relatively narrower SoA, restricting their perception of close-range emotional-interactions, and those with state anxiety have a relatively broader SoA, enhancing their perception of distant, negative, emotional interactions. The present findings indicate that individuals with mood disorders process emotional information differently than healthy individuals.

Keywords: depression, mood-disorder, scope of attention, state anxiety, trait anxiety, perception.

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DEDICATION

This thesis is dedicated to my family and friends: Devin, Ally, Vikki, Lawrie, Mark, Sigrid, Karen, Charlotte, Gail, and Anthony. Thank you for years of encouragement☺.

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CHAPTER ONE:

MOOD AND THE SCOPE OF ATTENTION

Choosing what to focus on, and what to ignore, affects the human perception of life; but so does one's mood. For most humans, mood can become more intense during emotional interactions. But emotions are transient, and if a low or high mood arises, it does not significantly affect the human perception of life negatively. But, for some, high mood-states are long-term, and cause negative behavioral, perceptual, and physiological consequences. Herein, we compare healthy individuals to those with mood pathology to ascertain if differences in the range or scope of attention affect the perception of the emotional world.

Disorders of Mood and Control of Attention

The World Health Organization (2017) estimates 264 million people, globally, will experience clinical levels (i.e., high, sustained or reoccurring impairment with measurable symptomology) of depression, and 284 million will experience an anxiety disorder. It is common to have more than one mood-disorder at a time (Lamers, et al., 2019; Langer et al., 2019). An estimated 85% of those who suffer mood-disorders reported serious to moderate impairment in daily functioning including attention deficits (World Health Organization, 2017). Stressful situations (i.e., test, evaluative, or competitive conditions; see Eysenck, 1992, for a review), trigger the worrying common to mood-disorders. Yet, it is

common to find that individuals who choose to be in a highly attention-dependent environment (e.g., university student populations) have high percentages of anxiety and depression (Beiter, et al., 2015; Latiff, & Aszahari, 2014; Mahmoud, Staten, Hall, & Lennie, 2012). This seems counterintuitive as mood-disorders are defined as 'disorders of attention' (Psychological Association Diagnostic and Statistical Manual, 2013), and one would hypothesize that individuals prone to these disorders would gravitate to less stressful surroundings to increase their chances of survival in these environments. However, this is not the case.

Attention and Survival

Attention is the ability to select the information that one wishes to identify, or focus on (Ahmed, & de Fockert, 2012; Bartés-Serrallonga et al., 2014; Haladjian, & Montemayor, 2015; Lupytan, 2015; Mack & Clarke, 2012; Moore & Zirnsak, 2017; Wolf et al., 2018; Wolf & Pfeiffer, 2014). Attention can concern a single sensory source (e.g., something seen, but not heard, or felt) or can be distributed among several information sources (Kolb, & Whishaw, 2015; Stone, 2012; Wright, &Ward, 2008). The focus of attention can be internal (i.e., thoughts), or external (i.e., environmental stimuli) (Chun, Golomb, & Turk-Browne, 2011). For the mechanism of attentional control to respond to the environment effectively, the brain must have the capacity to focus on certain stimuli to the exclusion of others. The brain's ability to discriminate stimuli is called *selective attention*, (Ahmed, & de Fockert, 2012; Ku, 2018; Moore &

Zirnsak, 2017; to name a few). The brain regulates what information is processed by a mechanism called *attentional control* (Figure 1).

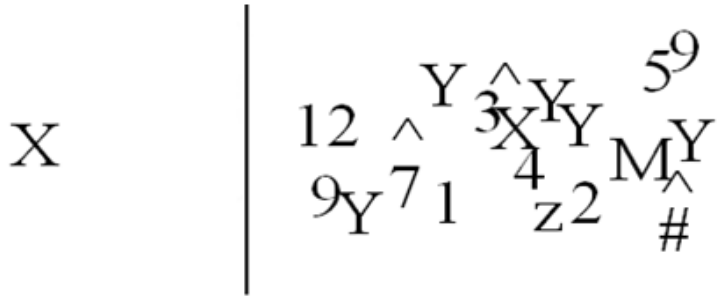


Figure 1. Basic Attention Control.
For 5 seconds, look for the 'X' on both sides of the image above. Attentional control mechanisms are utilized in processing both the left and right sides . The left requires less neural energy to focus on X; the right requires more. The left requires less ability to ignore non-relevant information (i.e., things that were not the X); the right requires more ability to ignore irrelevant information.

Attentional control allows an increase or decrease in the scope of the visual field based on the perceived survival relevance of a stimulus (Kolb, & Whishaw, 2015; Stöttinger, & Perner, 2006). This adaptive mechanism exerts a higher degree of control over what information is processed including emotional interactions, allowing exclusion of elements distracting from the current survival needs (Figure 2).

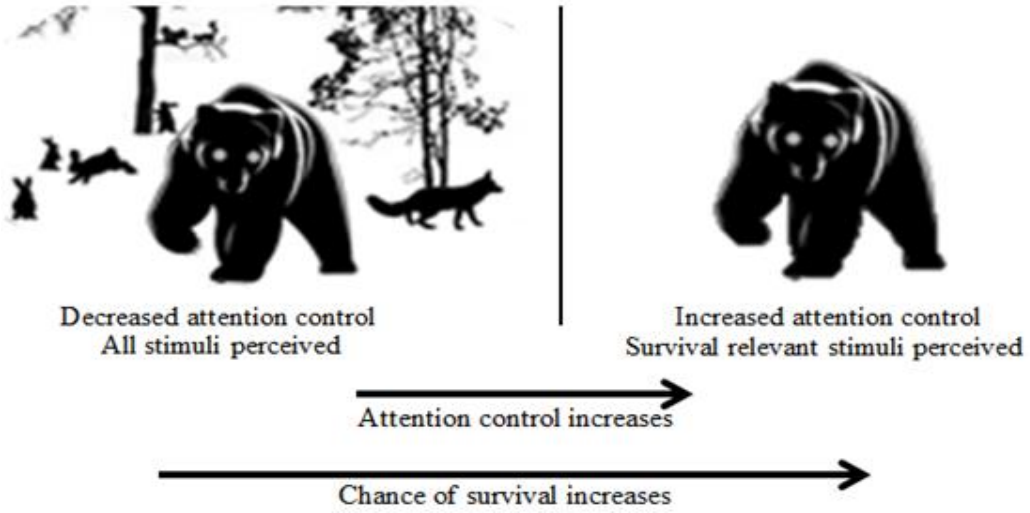


Figure 2. Survival Attention Control.
As dangerous stimuli get physically closer (left), attention control increases, to increase the chance of survival. Vision narrows to focus all attentional resources on the danger (i.e., items perceived as negative; the bear). The danger is given 'attentional priority'. Items perceived as 'not as dangerous' (e.g., bunnies, trees), or less likely to cause harm (i.e., farther away) are excluded from sight and perception (right) (Clipart Library, 2019).

Interestingly, those with clinical level depression (Dai, & Feng, 2011; Dai, Feng, & Koster, 2011) or anxiety (Berggren, Blonievsky, & Derakshan, 2015) experience decreased attentional control.

Attention's Scope and Perception

Attentional control ignores distractions by enabling the brain to focus neural resources (i.e., use selective attention) on specific stimuli which fall within certain visually perceivable distances, or ranges, called the *scope of attention* (Bartés-Serrallonga et al., 2014; Chen, Marshall, Weidner, & Fink, 2009; Haladjian, & Montemayor, 2015; Moore & Zirnsak, 2017; Rowe, Hirsh, &

Anderson, 2007; Wolf et al., 2018; Wolf & Pfeiffer, 2014). The scope of attention limits how much of the visual field surrounding the target stimulus will be perceived. A broad scope of attention allows more information to be perceived, and a narrow scope of attention allows fewer items to be perceived. Therefore, the scope of attention regulates human visual perception (Figure 3).

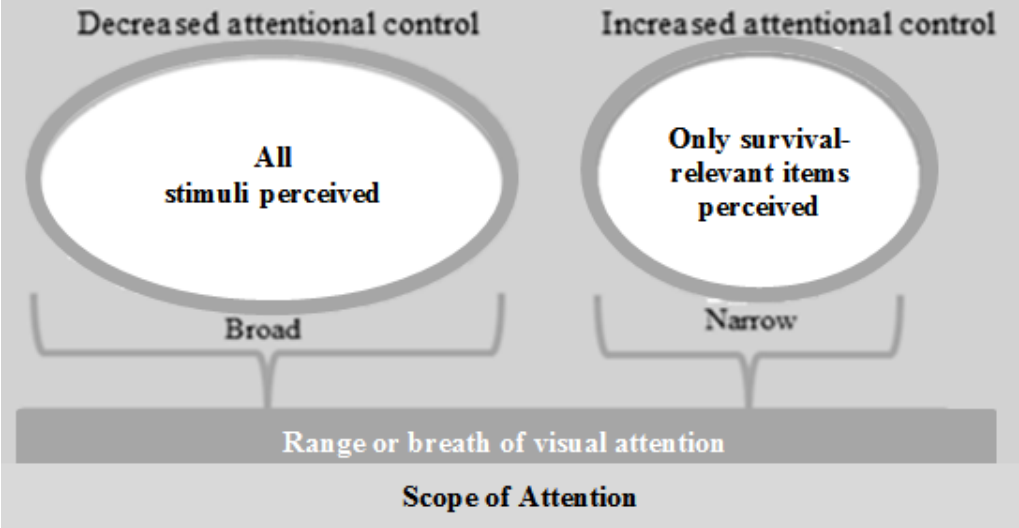


Figure 3. Broad and Narrow Scope of Attention.
Attentional control responds to emotional stimuli by either broadening or narrowing the scope of attention's range. This allows only survival relevant information to be perceived (i.e., white area inside gray circles). Gray circle = scope of attention, Broad = advantageous if no threat exists, Narrow = advantageous if threat exists. Items outside the circles (in light gray) cannot be perceived.

Perception and Social Interactions

To become aware of something through the human senses (e.g., visual and/or auditory and/or tactile), is called *perception* (Coon, & Mitterer, 2008;

Gregory, 1970; 1974; 1987; 1997; 2006*;* 2008; Haladjian, & Montemayor, 2015; Kolb, & Whishaw, 2015; Nichols, Brett, Andersson, Wager, & Poline, 2005; Pomerantz, 2003; Smith, Seger, & Mackie, 2007; Snyder, 2015). Herein, we will evaluate visual sensory perception.

Perception obviously includes social interactions (i.e., reoccurring contact with other humans; Boyd, & Richerson, 2009) which are vital to human survival (Coon, & Mitterer, 2008*;* Smith, Seger, & Mackie, 2007). But, how much we perceive of the world is directly related to the range of our scope of attention at the time of the experience (Figure 3). Therefore, over the course of human evolution, perception-related social attention allowed humans to become more adept at identifying (Stone, 2012; Whishaw, 2015), categorizing (Montemayor, & Haladjian, 2015), and selecting pertinent aspects of their social environment, thus increasing the chances of human personal and group/social survival (Brosch, Pourtois, Sander, & Vuilleumier, 2011; Graziano, 2014; Sander, & Vuilleumier, 2011). The identified and categorized information perceived by the individual must then be stored in the brain through a process called *memory* (Ahmed, & de Fockert, 2012; Amso & Scerif, 2015; Bartés-Serrallonga et al., 2014; Chun, Golomb,& Turk-Browne, 2011; Coon, & Mitterer, 2008; Haladjian, & Montemayor, 2015; Ku, 2018).

Information not perceived cannot be moved to memory (Heurley, & Ferrier, 2015; Martin, 1992; Mitterer, Horschig, Müsseler, & Majid, 2009). The human brain uses the items that can be perceived through visual attention, and

stored within memory, to construct an active, neural-processed map of the world (Coon, & Mitterer, 2008; Gregory, 1970, 1974, 1987, 1997, 2006, 2008; Haladjian, & Montemayor, 2015). Therefore, what humans are able to perceive through their current scope of attention, at any given moment, becomes their individual map of 'life'.

Perception's Cyclic Nature

This perceived map of one's life is strongly influenced by previous experiences (Ku, 2018; Schacter, Gilbert, & Wegner, 2011; Snyder, 2015; Stone, 2012). All experiences are cyclically utilized. That is, new experiences are interpreted in terms of past experiences, then stored in memory, and eventually utilized in the perception of future experiences. This influences the perceived probability (i.e., degree of belief; Gregory, 2006*)* that an event will occur (Gregory, 2008) during current or future interactions within the physical and social environment (i.e., if, each time you saw a sad-faced person, someone pinched your arm, then seeing a sad face may make you predict it is prudent to cover your arms, move away, or prepare for pain), This cyclic perceptional process (Friston, 2010; Tishby, & Polani, 2011) is a favorable, adaptive social-interaction mechanism (Barrett, 2017) as it allows constant data reevaluation.

The ability to cycle information allows the brain to process information differently depending upon whether or not that stimuli resemble previous experiences (i.e., whether the item has been seen before; *repetition*). The cycling mechanism also allows humans to make decisions about future events by

comparing newly perceived items to items in memory. The brain deems these items as ‘similar to’ (i.e., *congruent*), or ‘different from’ (i.e., *incongruent*) previously experienced stimuli (Bruner, & Postman, 2006; Schmidt, Notebaert, & Van Den Bussche, 2015; Snyder, 2015). Cycling shows the brains perceptual attention mechanisms are constantly adapting (Coon, & Mitterer, 2008; Haladjian, & Montemayor, 2015; Nieuwenhuis, et al., 2006) to allow the most advantageous interpersonal and social interactions possible.

Perception’s Neural Connection to Mood

The monitoring areas of the brain that allow humans to decipher social environments share neuro-anatomy with the regions utilized in emotion, emotional stimuli evaluation, and internal mood (Bas-Hoogendam, van Steenbergen, Tissier, van der Wee, & Westenberg, 2019; Izard, 2010; Kolb, & Whishaw, 2015; Schulze, Schulze, Renneberg, Schmahl, & Niedtfeld, 2019). This allows internal mood to interact with the perception of any social interaction, to affect and be affected by decision making or emotions (Schnyer et al., 2015), and to modify external factors, such as the perceived emotionality of environmental stimuli (Barratt & Bundesen, 2012; Diéguez-Risco, Aguado, Albert, & Hinojosa, 2015; Kanske, & Kotz, 2011). Together, these common brain areas connect perception of social-emotional interactions to mood-state (Barrett, 2017).

During social perception, the human brain uses the repeated or cyclic observation-process to make ‘informed decisions’ about where a conversation is

leading (Snyder, 2015), or what threat level is present when approaching another human (Haladjian, & Montemayor, 2015; Pomerantz, 2003). The brain utilizes the human face to perceive the current emotional state or overall mood of another human being, even without the presence of spoken language (Kolb, & Whishaw, 2015; Stone, 2012). This non-verbal emotional communication is so important to human social survival that social-emotional perception is supported by neural circuitry designed for the task of face recognition and facial expression identification (Barrett, 2017; Mumenthaler, 2012; Xie, & Zhang, 2016). These responses to the emotional world are affected by their congruency with the individual's past experience (Gilbert & Li, 2013; Haladjian, & Montemayor, 2015; Jensen et al., 2015) and the individual's internal mood-state (Coon, & Mitterer, 2008). Basically, humans are hard-wired to decipher other human's emotional-mood state quickly and efficiently, and then make decisions about the person's future approachability.

Perception of Social Harm to the Self

In the presence or absence of potential social (or physiological) harm, attentional control uses the scope of attention like a cage, or bubble, to visually scale the amount of environmental information which can be observed (Öhman, 2000; Öhman, & Mineka, 2001; Olsson, & Phelps, 2007) (Figure 3). It is important to note that whether the perceived social harm is psychological or physiological, the scope of attention responds to the emotional strength (i.e.,

salience), and perceived ‘good-ness’ or ‘bad-ness’ (valence) of the stimuli (Barratt, & Bundesen, 2012; Chen, Marshall, Weidner, & Fink, 2009). In healthy adults, the scope of attention narrows the range of items which can be perceived when negative emotional stimuli replace neutral or positive stimuli. (Bartés-Serrallonga et al., 2014; Haladjian, & Montemayor, 2015; Moore & Zirnsak, 2017; Rowe, Hirsh, & Anderson, 2007; Wolf et al., 2018; Wolf & Pfeiffer, 2014) (Figure 4).

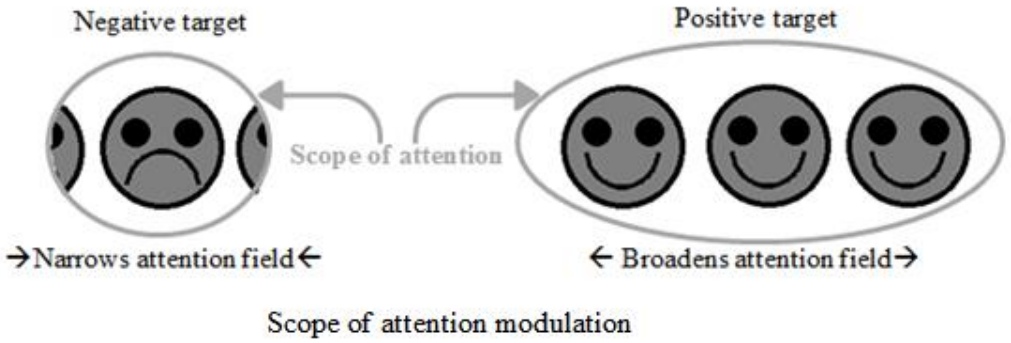


Figure 4. Perceived Emotionality’s Effect on the Scope of Attention.
The perceived ‘goodness’ or ‘badness’ of stimuli triggers the scope of attention to respond. In healthy participants, the scope narrows to negative stimuli and broadens to positive stimuli. Gray circle represents the scope of attention. Target (i.e., center image in circle) (O’Donnell, & Koshino, 2017).

Social Transmission of Mood

In social interactions, attention-resources are highly focused on the short-lived feelings (i.e., emotions) of others. Perceived or experienced emotions can produce changes in mood. Moods are defined as having no clear starting or ‘formation’ point (Izard, 2010), but a person’s mood-state is innately perceivable by other humans (Eldar, Rutledge, Dolan, & Niv, 2016; Eldar et al., 2016). This

suggests that mood is socially-transmittable. Research shows that mood also affects internal information processing. For example, when a person is in a positive mood, and then encounters someone in a negative mood, a mood-change occurs in response (Rey, et al., 2014). Interestingly, this change occurs before the human brain has time to rationally evaluate if a mood-change is preferable (Bas-Hoogendam, et al, 2018; Bas-Hoogendam, et al., 2019).

This social transmission of mood allows one human to evaluate another human's level of, or need for, social interaction or support, while reinforcing information regarding danger level (Bishop, Duncan, Brett, & Lawrence, 2004; Bunford, Kinney, Michael, & Klumpp, 2017; Burkhouse et al., 2018; Burklund, Torre, Lieberman, Taylor, & Craske, 2017; Öhman, 2005). These aspects make the social transmission of mood a way to translate the human emotional-state, and our 'emotional need', to others in our vicinity. Therefore, the social transmission of mood is a survival-based adaptation to foster intra-social support and functioning (Bas-Hoogendam et al., 2019; Graziano, 2014); again, increasing the groups likelihood of survival.

Mood, Emotion, and Congruency

The human ability to visually decipher others external emotional states also influences survival ability. Once the external emotion is perceived, the internal emotional response deploys a different amount of attention to stimuli dependent upon the stimuli's emotion-type (i.e., happy; positive, sad; negative) (Amso & Scerif, 2015). As we know, emotion affects mood, and mood can be

transferred. The transference of these moods affects others' emotional-responses and behavior. Positive mood enhances performance tasks (Rowe, Hirsh, Anderson, 2007); which could lead to more efficient academic or social functioning. Negative mood affects the judgment and the perception of objects and events (Snyder, 2015); which can lead to problems in social relationships.

Congruency (i.e., the sameness or difference in something compared to what you already have experienced) also interacts with mood. Niedenthal and Setterland (1994) found that individuals have a heightened perception for things that are congruent with (i.e., the same as) their current mood. But humans cannot obscure mood-state as easily as their emotional state (Barrett, 2017). Not being able to obscure one's mood state could be advantageous socially, allowing others to respond, or it could be disadvantageous psychologically, as an individual's level and type of mood is closely tied to their sense of emotional well-being. This has been well-studied in individuals with high mood levels of anxiety (Picó-Pérez, Radua, Steward, Menchón, & Soriano-Mas, 2017) and/or depression (Anand et al., 2005; Yin, Hou, Wang, Sui, & Yuan, 2015).

Since the emotional value of stimuli affects the human scope of attention, and there is a preference for things that are congruent to one's mood state, a disorder of mood could exert significant control over one's perception of the world.

Mood: Transient and Non-transient

Healthy individuals have transient (or short-duration) high-moods (i.e., one anticipates going to a concert of their favorite band, which results in a sustained high, positive mood for the week before) and transient low-mood (i.e., a cherished family pet dies and a low, negative mood may be sustained for weeks). Furthermore, transient mood-states can last for extended periods without being a maladaptive pattern (i.e. pathologic) (Bishop, et al., 2004; Burkhouse et al., 2018). Non-transient (i.e., long-lasting) mood-states (e.g., as in high anxiety or high depression) cannot generally be related to a specific cause. Anxiolytic or depressed mood decreases the likelihood of positive social interactions (Anxiety: Picó-Pérez, Radua, Steward, Menchón, & Soriano-Mas, 2017; Depression: Anand et al., 2005; Yin, Hou, Wang, Sui, & Yuan, 2015).

CHAPTER TWO:

MOOD, THE BRAIN, AND BEHAVIOR

Attention Control in the Brain

The neurological ‘circuitry’ underlying attentional controls (e.g., attention, selective attention, scope of attention, stimuli congruency) is vast (Baluch & Itti, 2011; Moore & Zirnsak, 2017; Wolf et al., 2018). These neural circuitries serve the human brain’s need to intricately decipher, evaluate, and hypothesize about (Gregory, 1980) environmental information. However, one’s mood-state also affects what an individual hypothesizes to be ‘true’ (i.e., how humans think/perceive reality), how their bodies function (Gohd, 2017; Kolb, & Whishaw, 2015), and how they respond to their environment (Shackman, Salomons, Slagter, Fox, Winter, & Davidson, 2011).

Mood and the Cingulate Cortex

What humans visually attend to (i.e., focus on) are stimuli, and as we have noted, stimuli’s emotion type causes specific changes in the amount of items (or data) the human brain will allow to be attended to (e.g., the scope of attention changes). Visual attention to emotional stimuli is accomplished by the anterior and mid-cingulate cortex (ACC and MCC, respectively; Bush, Luu, & Posner, 2000; Chen, Marshall, Weidner, & Fink, 2009; Etkin, Egner, & Kalisch, 2011; Haladjian, & Montemayor, 2015; Hall, 2011) (Figure 5).

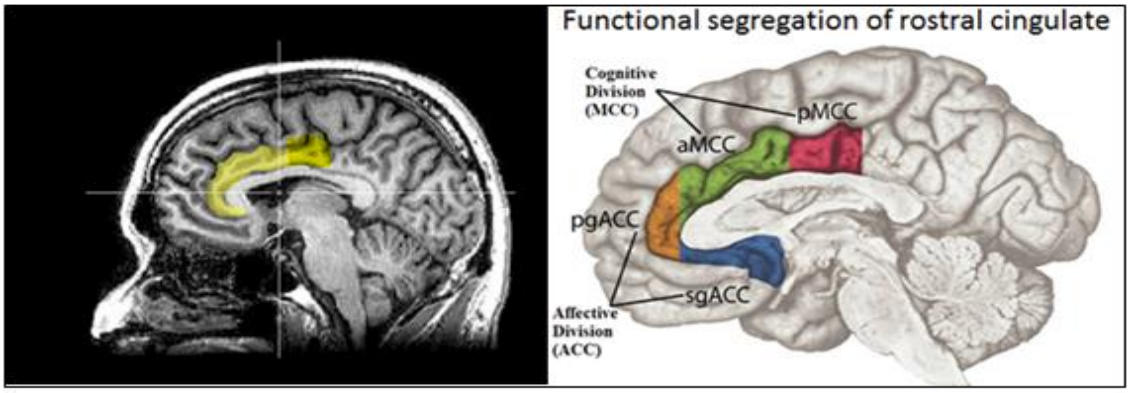


Figure 5. Emotional Attention in the Brain: Rostral Cingulate Cortex. (Left) Anterior cingulate cortex (ACC) and adjoining mid-cingulate cortex (MCC) are highlighted in yellow (Hall, 2011). (Right) Cognitive control (i.e., making decisions) is accomplished by the mid-cingulate (aMCC: green) and posterior-cingulate (pMCC: red). The affective (i.e., emotionally-linked) division is the pregenual (pgACC: orange) and subgenual (sgACC: blue). These adjoining locations allow the ACC/MCC to access thought, emotion (including fear via amygdalae), and mood related input (Adapted from: Bush, Luu, & Posner, 2000).

Subtle, rapid cognitive-emotional changes can be assessed by the ACC/MCCs monitoring ability (e.g., interpretation of facial expressions, body posture, and verbal tone). These changes can be measured through neuroimaging (Panksepp & Biven, 2012; Harmon-Jones, Harmon-Jones, & Price, 2013). Higher mood scorers have significantly higher or lower neural excitation (i.e., chemical electrical ‘firing’ of neurons) in one brain region, or between multiple regions (i.e., in functionally connected brain areas; Kolb, & Whishaw, 2015) when responding to an object (generally appearing on a monitor screen, as in the experiment, herein).

Labuschagne, and colleges (2012) found higher ACC activation (i.e. more utilization of neural resources) in anxiety sufferers than in healthy controls during

the viewing of emotionally negative stimuli (Berggren, et al, 2015; Berggren & Derakshan, 2013). In depressives, Miskowiak et al. (2015) found that both high-risk adult twins (i.e., one twin with clinical depression history, one without) showed increased neural response to happy and fearful faces in the dorsal ACC and displayed increased attention vigilance for fearful faces, compared to low-risk twins (i.e., neither twin had a history if depression) (also see Bodenschatz, Skopinceva, Kersting, Quirin, & Suslow, 2018 regarding sad face responses in depressives).

Socially, the ACC/MCC allows for an understanding of another person's internal mood alterations, and gives information about the probability of external aggressiveness or kindness (Shackman, Salomons, Slagter, Fox, Winter, & Davidson, 2011). The ACC/MCC also monitors emotion-related or 'affective' conflicts or congruencies (i.e., like seeing a happy friend surrounded by sad friends; ☹☺☹). But when the ACC is unable to properly process incoming data, a maladaptive loop of emotional distress is created (Polli, et al., 2005), which drains attentional resources (Wei, Szameitat, Müller, Schubert, & Zhou, 2013). This attentional resource drain, inherent to mood-related emotional processing, has been known to affect the rate of neural processing (i.e., creating slower reaction times to stimuli) and thus is evidenced in behaviors.

Mood-disorders and Behavior

Behaviorally, mood disorders (e.g., anxiety, depression) share symptomology, making them hard to differentiate (i.e., those with depression and

anxiolytic disorders experience cyclic thought patterns; Psychological Association Diagnostic and Statistical Manual, 2013; Schulze, Schulze, Renneberg, Schmahl, & Niedtfeld, 2019; World Health Organization, 2017). The occurrence of mood-disorder comorbidity is high (depression is often accompanied by anxiety, and vice-versa; Lamers, et al., 2019; Langer et al., 2019). This may explain mood-disorder overlaps in symptomology. These factors can create research confounds, but it remains the case that the unique behavioral effects of the different mood disorders have been demonstrated in human subjects (Arbabshirani, et al., 2017; Woo, Chang, Lindquist, & Wager, 2017) even in the presence of mood-comorbidities (Spielberger, et, al., 1983; Vitasari, et al., 2011; Yang, et al., 2016). Herein, we will investigate whether high mood, human participants, with mood-disorder comorbidities exhibit unique or differential behavioral effects than controls, by using an attention task which has been shown to engage the scope of attention in healthy subjects.

CHAPTER THREE:

MOOD MEASUREMENT: TASK AND THEORY

The Flanker Task

One of the best-known measurements of attention is the flanker task (Ericksen and Erickson, 1974; Eriksen, & Schultz, 1979; Eriksen, & Spencer, 1969; Schmidt, & De Houwer, 2011; Wendt,& Luna-Rodriguez, 2009) . The flanker task has been shown to be effective in a large range of experimental paradigms, such as during stimuli sequences (Schmidt, & De Houwer, 2011; Nieuwenhuis, et al., 2006; Wendt, & Luna-Rodriguez, 2009),with emotional stimuli (Barratt & Bundesen, 2012; Fenske, & Eastwood, 2003), and during the use of electrophysiology/neuro-imaging (Purmann, Badd, Luna-Rodriguez, & Wendt, 2010; Ullsperger, & von Cramon, 2001; Lamers, et al., 2019).

During the flanker task, participants respond to a centered target stimulus which is 'flanked' or surrounded by distractor stimuli on either side (Eriksen, & Eriksen, 1974; Eriksen, & Schultz, 1979). The flankers may be the same as the target (congruent; → → →) or different from the target (incongruent; ← → ←). Human neuro-imaging and computationally modeled data have shown congruent trials produce less neuronal excitation than incongruent trials (Kinoshita et al., 2011). When the mean response on incongruent trials is significantly longer (i.e., slower) than the mean response on congruent trials, it is known as a *congruency effect* (Barratt & Bundesen, 2012; Eriksen, & Eriksen, 1974; Janczyk, & Ulrich, 2019) (Table 1).

Table 1. Effect Calculations

Effect*	Calculation
Target**	Significant difference between Happy and Sad targets
Distance+	Significant difference between Near and Far distractors
Congruency++	Significant difference between Congruent and Incongruent distractors
Attentional scope	Broad (Scope of attention): Congruency effect present Narrow (Scope of attention): Congruency effect absent

*Calculated in mean reaction time (ms.)

**Effect of the emotionality of the target

+Distance from the target

++Sameness to, or difference from the target emotion

The flanker task has the capacity to assess the participant's inhibitory processes (i.e., the individual's ability to ignore irrelevant data) during responses to the target which is in the presence of a distractor. The measurement of these inhibitory processes allows the breath of the scope of attention to be calculated via the attentional scope effect (Table 1). This makes the flanker task especially suited for the emotion-based attentional scope experimentation, herein.

Effects of Stimuli and Distractors

In addition to congruency, there are several other well-established effects with the flanker task and some of these interact with congruency (Eriksen, & Eriksen, 1974). These include effects based in the nature of the target stimulus (e.g., *target effects*; Table 1).Target effects occur where one target takes longer to respond to than another (Eriksen, & Eriksen, 1974; Eriksen, & Schultz, 1979; Neumann, & DeSchepper, 1991; Li, Miller, & Desimone, 1993). Research using

emotional stimuli (Fenske, & Eastwood, 2003) have demonstrated target effects based in the valence (i.e., positive emotion vs. negative emotion) of the target. Reaction time is generally longer for negative emotional stimuli.

An effect can also be seen in the location of the distractor in reference to the target's location: called a *distance effect* (Table 1) (Eriksen, & Eriksen, 1974; Hübner, & Töbel, 2019; Mattler, 2006; Miller, 1991; Olk, Dinu, Zielinski, & Kopper, 2018). A distance effect occurs when distractors which are farther away from the target are responded to more slowly than distractors which are located closer to the target. Distance effects are common and can be helpful in the measurement and confirmation of scope of attention changes when comparing one target-type or distractor-type to another (Ahmed, & de Fockert, 2012; Hübner, & Töbel, 2019; Rowe, Hirsh, & Anderson, 2007).

An *attentional scope effect* (i.e., the change of the perceptible, scope of attention during emotion-linked stimuli; Table 1) involves the broadening or narrowing of the range of attention as a function of the emotional valance of the target and/or the mood of the participant. Attentional scope effects are most clearly measured through manipulations of congruency. A congruency effect suggests that a relatively broader attentional scope was maintained, because, without a broad scope of attention the similarity or difference between a target and a distractor could not be seen. That is, a significant disparity in reaction times between incongruent and congruent conditions requires that attentional scope be broad enough to include the target and the distractors (Figure 6).

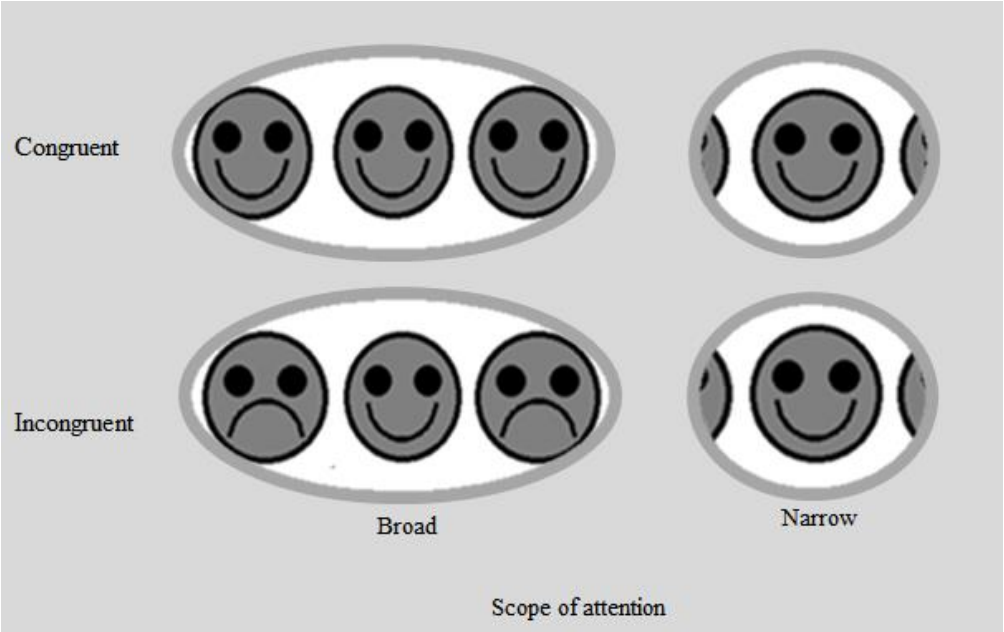


Figure 6. Scope of Attention-distractor Relationship.
The difference between congruent (top) and incongruent (bottom) distractors, during focus on happy targets can only be identified when the scope of attention is broad enough for the distractors to be perceived.

A further assessment of attentional scope can be made by way of the interaction of congruency and distance effects. For example, if healthy controls have a congruency effect in the near but not the far condition, and a high mood group has a congruency effect in the near and far conditions, we could conclude that the high mood group had a broader attentional scope than the healthy controls.

It is thought that both target and congruency effects may result from *feature repetition* (Eriksen, & Schultz, 1979; Hübner, & Töbel, 2019; Nieuwenhuis, et al., 2006; Schmidt, & De Houwer, 2011; Schmidt, Notebaert, & Van Den Bussche, 2015). The more humans see something, the easier it is to learn what to do in response to that 'thing' the next time it is presented in the

environment. However, feature repetition does not explain why objects closer to the target are responded to faster than objects farther away. Alternatively, target, distractor and distance effects could be a product of conflict monitoring (i.e., in the ACC/MCC of healthy individuals), as all target and distractor changes would be processed differently, corresponding to the current level of danger. This would even apply to distance, as something closer to you (i.e., allowing you access to more data for evaluation and categorization) could be visually evaluated faster than something farther away (Eriksen, & Eriksen, 1974; Hübner, & Töbel, 2019; Mattler, 2006; Miller, 1991).

Effects of Emotional Stimuli

To gauge the effects of attentional scope, we need a device that will reliably and accurately transmit the proper emotion to the participant. One of the most intuitive ways humans communicate emotional information is through facial expressions. Keltner, and Ekman (2003) found that facial emotions are universally recognized, are associated with specific facial expressions, and are direct indicators of internal affective attitudes and dispositions (i.e., mood-state). Hoemann and Barrett (2018) found that sensory feedback from movement of facial muscles contributed to the internal occurrence of the emotional feeling (i.e., creating a feedback loop). This emotional-physiological feedback loop allows the individual to influence their own emotion state by the initiation of voluntary facial expressions (Beamish, Foster, Edwards, & Torsten, 2019; for further discussion of the feedback loop *see* Pressman, Jenkins, & Moskowitz, 2019). Emotions

result in physical and psychological changes (Schacter, Gilbert, & Wegner, 2011) that influence personal behaviors (Wilson-Mendenhall, Henriques, Barsalou, & Barrett, 2019) and the behaviors of others (Beamish, et al., 2019) in evolutionarily adaptive ways. The moment to moment human emotional experience corresponds to the specific patterns of emotional stimuli seen in facial expressions (Barrett, 2017). Both the monitoring of one's own emotional states and the monitoring of emotions in others play a vital role in human perception (Gayet, Van der Stigchel, & Paffen, 2014; Gröne et al., 2015).

These results show substantial evidence that the human face is a reliable, attention-grabbing stimulus, which can accurately transmit human emotional states to other humans without further output (i.e., without additional speaking, writing, etc.). Interestingly, schematic representations of the human face (i.e.,☺, or ☹) produce similar neural activations to actual images of human faces during functional magnetic resonance imaging (Britton, Shin, Barrett, Rauch, & Wright, 2008; Wright, Martis, Shin, Fischer, & Rauch, 2002), making schematic emotional stimuli, an effective and reliable tool for the transmission and assessment of visual emotional attention content in behavioral experimentation.

Effects of Emotional Face Stimuli

The effects of emotional face stimuli during attention tasks are well documented. Barratt and Bundesen (2012), Gable and Harmon-Jones (2012), and Rowe, Hirsh, and Anderson (2007) found consistent results, producing significantly longer response times to negative emotions (e.g., sad faces;☹) than

to positive (e.g., happy faces;☺). Rowe, Hirsh, and Anderson (2007) also found positive emotional states broaden the scope of attention. Gable and Harmon-Jones (2012) found negative emotional states narrow thought and action in healthy subjects.

Most importantly, Barratt and Bundesen (2012) found congruency effects to happy-target schematic faces and not sad faces; demonstrating that viewing negative environmental stimuli narrowed the scope of attention in healthy subjects. In other words, when negative emotional stimuli were presented to the participant, the breath of their field of visual perception narrowed. This narrowing of the perceptible world reduced the observable emotional stimuli around the negative target (i.e., a narrow attentional scope effect; Table 1). These results indicate that emotional schematic faces can be used to trigger measurable changes in the scope of attention (Figure 7).

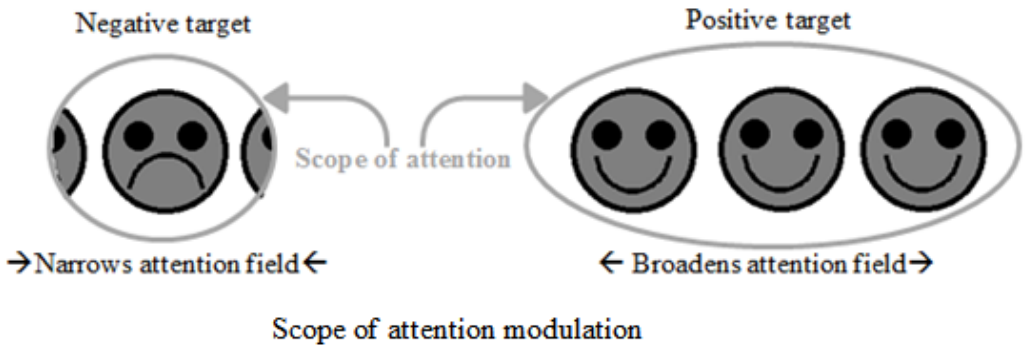


Figure 7. Scope of Attention during Schematic Emotional Targets. Schematic emotional targets (i.e., center image) affect the modulation, or the breath of the stimuli perceived through the scope of attention (O'Donnell & Koshino, 2017), in healthy individuals.

Effects of Distance upon Stimuli Perception

By manipulating the relative distance of the emotional distractor-faces, we get a glimpse of how much information the individual's scope of attention is allowing them to perceive while processing a particular target emotion (i.e., while focusing on an emotional face-type; ☺ or ☹, can the participant perceive the difference, or do they exhibit a different RT to distractors which are happy or sad; ☺☺☺ or ☹☺☹, ☺☹☺ or ☹☹☹), in the near location (i.e., ☺☺☺) and the far location (i.e., ☺ ☺ ☺) (Rowe, Hirsh, & Anderson, 2007). Including distance as a factor provides data on the relative width of the scope of attention during a specifc, proximal or distal emotional-stimuli responses which are not the focus of selective attention, but greatly influence the human ability to gauge our external emotional environment (For survival see: Diéguez-Risco, Aguado, Albert, & Hinojosa, 2015; Kanske & Kotz, 2011, for distance see: Eriksen, & Eriksen, 1974; Hübner, & Töbel, 2019; Mattler, 2006; Miller, 1991).

Additionally, the individuals internal perception of an item is dependent upon the inherent emotionality of the stimulus presented (i.e., whether the item conveys 'happy' or 'sad') (Chen, Marshall, Weidner, & Fink, 2009). Therefore, it is experimentally reasonable to extrapolate that the emotion the individual 'perceived' at that moment corresponds to the RT produced in response (i.e., a sad face target with sad distractors which are presented far from the target would be responded to slower than distractors near to the target, and therefore, the near and far distractor conditions would be perceived as 'different'; RT to ☹ ☹ ☹

> ☺ ☹ ☺). Thus, the reaction to the distance of emotional stimuli allows the statistical evaluation of the participant's perception of a particular emotion-liked target-distractor relationship. This target-distractor-distance data informs us as to the breath of the scope of attention at the moment the participant experiences the emotional stimuli.

Fear's Role in the Task

Within the flanker task, the narrowing of the scope of attention to 'negative' stimuli is the same response exhibited during fear (Bracha, 2006). Fear is associated with activation of the amygdala (Britton, Shin, Barrett, Rauch, & Wright, 2008) the same area which informs the ACC when processing emotions and mood. Fear is defined as an unpleasant emotion involving the belief that someone or something is dangerous (Farb, Chapman, & Anderson, 2013; Öhman, 2000) or likely to cause pain. Fear perception is possibly the most important perception in the survival of homo-sapiens (McFadyen, 2019; Olsson, & Phelps, 2007) specifically because fear and the scope of attention are so interdependent in the healthy human brain. Each time we measure a participants reaction time to a sad-face, we are gauging their fear response (Chen, Marshall, Weidner, & Fink, 2009; Rowe, Hirsh, & Anderson, 2007).

Fear Perception in Mood-disordered Individuals

Research has found that anxiolytics' cyclic fear-based biases focus on the expectation of future threat (Bishop et al., 2004; Burkhouse et al., 2018;

Heitmann et al., 2017), whereas, those with depression tend to cycle remembrances of past fears (Langer et al., 2019). For each, imagining of these fears creates a perceived loss of emotional control (Farb, Chapman, & Anderson, 2013). This perceived loss of control is often internalized by those with mood disorders as perceived physical threat (American Psychological Association, 2013). Research has found that the perceived threat prevalent in anxiety and depression is accompanied by the same physiological responses (i.e., muscular tension), and cognitive difficulties (i.e., unfocused concentration) experienced during periods of physiologically-based fear.

It is hypothesized that this perceived fear and the ensuing loss of control fuels cyclic thought (i.e., rumination or worry), increasing neural excitations in mood-processing regions of the brain, and strengthening connections perpetuating mood disorders (Nolen-Hoeksema, Wisco, and Lyubomirsky, 2008). The neural resources which are being limited by cyclic thoughts in mood-disorders are, therefore, less available for paying adequate attention to their environment (Öhman, 2000). Craske, and Stein (2016) surmised that during mood disorders, a fear-based ‘effect precedes cause’ relationship exists, where the cyclic expectation of fear evidences in fear prior to the trigger for fear (Craske, & Stein, 2016). Furthermore, these cyclic thought patterns of anxiety and depression persist even when the mind is not directly thinking of the fear-related stimuli (Bishop et al., 2004; Burkhouse et al., 2018; Heitmann et al., 2017; Langer, et al., 2019). These constant fear-related thoughts lead to corresponding

behaviors which can be measured during attentional tasks. The ability of attentional tasks to evaluate mood-disorder variances is best explained by the Attentional Control Theory (Eysenck, Derakshan, Santos, & Calvo, 2007).

The Attentional Control Theory

The *Attentional Control Theory* (ACT: Eysenck, Derakshan, Santos, & Calvo, 2007) unites the effects of the target, the distractors, distance (from target to distractor), and scope of attention (the breath of perceptible information) by focusing on the comparative neural processing efficiency of those with anxiety versus healthy controls (Eysenck, & Derakshan, 2011). The ACT attempts to explain the effect of mood on performance during tasks that require overall attention-control. The ACT has also been used to evaluate the attention of those with depressive symptomology (Joormann & Gotlib, 2008) because anxiety disorders and depression share cyclic fear-related thought patterns. And as we have discussed, fear has a direct correlation with the activation of the scope of attention. Research shows that the attention-related aspects of working memory are impaired during anxiety (Eysenck, & Derakshan, 2011), and can be compared to the impaired attentional control during depression (Bodenschatz, et al., 2011; Dai, Feng, & Koster, 2011; Joormann & Gotlib, 2008).

Individuals scoring in the high anxiety range (Englert, & Bertrams, 2015) or the high depression range (Joormann & Gotlib, 2008) on self-report measures of mood, have been found to pay more attention to irrelevant stimuli (i.e., have less attentional control and exhibit a broadened attentional scope).This

commonality in behavioral symptomology between anxiety and depression is thought to directly relate to cyclic thought patterns (i.e., worry over potential consequences for failing to appropriately function in certain circumstances) (Bodenschatz, et al., 2018).

Thus, the ACT links the ideas that cyclic thought 'over-utilizes' working memory capacity, and influences performance during tasks which require efficient attention regulation (Eysenck, Derakshan, Santos, & Calvo, 2007). Therefore, disorders that include ruminative symptomology are thought to hinder efficient regulation of the scope of attention (i.e., the attentional scope)by disrupting the balance between what the brain is attempting to focus on, and the novel, different, threatening, or surprising stimuli to which the brain automatically attends (Corbetta and Shulman, 2002).

Despite this similarity between anxiety and depression with regard to the attentional scope there may be differences in regard to other aspects of attention. Eysenck, Derakshan, Santos, and Calvo (2007) argued that anxious individuals can perform as accurately (i.e., anxiolytics achieve the same level of correct answers) as non-anxious individuals because they counteract their automatic processing deficits by investing additional neural effort (i.e., anxiolytics take longer, but get the correct answer) (Nieuwenhuys & Oudejans, 2012; see Seipp, 1991 for academic settings; Woodman & Hardy, 2003 for sports settings; Vytal, Cornwell, Letkiewicz, Arkin, & Grillon, 2013). Thus the anxious have to mentally try harder to obtain the same level of attentional focus as healthy controls.

Conversely, depressives are less accurate (i.e., depressives achieve less correct answers in the same time period as healthy controls) (Bodenschatz, et al., 2018), with higher depressive symptomology relating to a greater bias towards happy faces.

As a whole, those with mood-disorders have been shown to have biases in attention control that are not seen in healthy individuals. The ACT posits that the differences are affected by, or have caused, unhealthy resource utilization. Evidence seems to suggest that the differences in the mood-disordered brain are partly due to the loss or usurping of neural resources. But little research has been conducted to determine how this maladaptive resource utilization affects the perception of life.

Research has shown that items not perceived (for whatever reason) cannot be moved to memory (Heurley, & Ferrier, 2015; Martin, 1992; Mitterer, Horschig, Müsseler, & Majid, 2009), and that human visual attention is a major source of externally derived, but memory-allocated information (Coon, & Mitterer, 2008*;* Haladjian, & Montemayor, 2015; Gregory, 1970, 1974, 1987, 1997, 2006, 2008) – the very information used to construct the internal 'map of human existence'. So, the question becomes, do mood-disorder induced deficits in resource utilization affect the individual's perception of life. Said differently, would two individuals, one with a mood-disorder and one without, both perceive an emotional situation in the same manner?

Herein, we utilized the inherent mechanisms of attentional control to activate the scope of attention of individuals with mood-disorder symptomology and without, to identify if mood-disorders alter visual emotion perception.

CHAPTER FOUR:

RATIONALE FOR THE PRESENT STUDY

Rationale

The rationale for this study is to ascertain whether mood disorders affect the scope of attention (i.e., broaden or narrow the attentional scope effect; ASE, Table 1) during emotional interactions; thus, altering perception. Toward this end, we have evaluated the similarities between anxiety and depression. First, depression and anxiety are highly correlated in the general population. Second, both depressives (Dai, & Feng, 2011; Dai, Feng, & Koster, 2011) and anxiolytics (Berggren, et al., 2015) experience decreased attentional control, specific to inhibition. Third, both depression (Bodenschatz, et al., 2018) and anxiety (Eysenck, Derakshan, Santos, & Calvo, 2007) share increased attention to sad faces. Fourth, anxiety and depression share similarities in the role cyclic thoughts play in the taxing of working memory capacity. Fifth, both tap into the fear response and its subsequent functions. Sixth, both share brain activation areas.

These similarities lead to the supposition that there may be a single, unifying function across anxiolytic and depressive disorders. This common function would seem to concern the scope of attention. The scope of attention has been shown to be active in both anxiety and depression; is affected by global attentional control; is part of the fear response; functions by using the same brain areas as mood disorders; functions in a feedback loop; is modulated by the emotionality of the target; and affects the perception of emotional stimuli, thus,

affecting performance on attention tasks. Since depression and anxiety are highly correlated, it seems reasonable to expect that they would share similar deficits with regard to attentional control; like the scope of attention.

Despite these reasons for predicting common attentional deficits across the mood disorders, we can expect differences as well. Researchers found limited evidence indicating that attentional scope may be affected differently in anxiolytic (Bowler, et al., 2012) and depressive disorders (Bodenschatz, et al., 2018; Dai, & Feng, 2011; Dai, Feng, & Koster, 2011; Joorman, & Gotlib, 2008). In addition, we know anxiety sufferers achieve healthy control levels of performance by exerting more effort, thereby taking longer than healthy controls to respond (Eysenck, Derakshan, Santos, & Calvo, 2007; Nieuwenhuys & Oudejans, 2012; Seipp, 1991; Woodman and Hardy, 2003; Vytal, et al., 2013). But, in depression, high brain activations decrease performance accuracy (Bodenschatz, et al., 2018). Additionally, the effects already noted (i.e., a decreased ability to inhibit negative distractors) may have varying consequences per each mood-disorder (Dai, and Feng, 2011; Dai, Feng, & Koster, 2011).

To add to the possible effect variances per mood-disorder, anxiety has two main types: Trait, (i.e., generalized to all situations or all of the time) and state (i.e., occurring in specific situations or at this moment). Individuals with trait anxiety (Rothbart, Ellis, Rueda, & Posner, 2003) have been found to have low overall attentional control, which has been shown to increase RTs to stimuli (Bowler, et al., 2012; Eysenck, Payne, & Derakshan, 2005). Berggren, et al.

(2015) found that trait anxiolytics also have enhanced visual detection abilities to facial emotions (i.e., are more susceptible to stimuli, regardless of stimulus type), which is consistent with reacting faster to emotional stimuli than healthy controls.

Eysenck, Payne, & Derakshan, (2005) found that state anxiolytics (i.e., situational anxiety) were able to narrow scope of attention during the presentation of negative stimuli (i.e., mirroring healthy individuals), while confirming that state anxiolytics were slower to achieve the inhibitory response (i.e., had significantly slower RTs). Trait anxiolytics and depressives have commonalities as well. Trait anxiolytics and depressives were not able to narrow scope to negative distractors (i.e., they experienced a broad ASE to negative flanking or surrounding information that might otherwise be forcibly ignored or excluded from the individuals perception). It is important to note that this commonality in trait anxiolytics and depressives is reflective of the brains processing of the distractors, and does not relate to the target; ☹Ø☹) (Dai, & Feng, 2011; Dai, Feng, & Koster, 2011). However, state, trait and depression were also found to have a bias for fear or 'danger' target-items (i.e., as when a sad face is focused upon; Ø☹Ø), allowing negative targets to capture attention, thereby slowing the RT of the participant (Langer, et al, 2019).

Lastly, it is important to note that the findings discussed in this rationale section generally involve longer RTs for mood disorder groups. These longer RT's were described in the various literary findings as: 'low attentional control', or 'having a bias for' negative or positive targets or distractors, or 'having an inability

to ignore' distractors when compared with healthy individuals (i.e., there was little commonality in the naming of the attentional factors). The non-standard labeling of attentional control mechanisms makes findings difficult to interpret, and to use for predictions. Once the intervening factors already discussed are added to the evaluation of moods effect upon emotional attention processing, we are left with an even more complex evaluation.

Therefore, to clarify the current findings, and to assist in the development of realistic experimental expectations, the various independent findings were integrated into a literature-based, functional representation or 'map' of mood-dependent emotional attention responses (Figure 8).

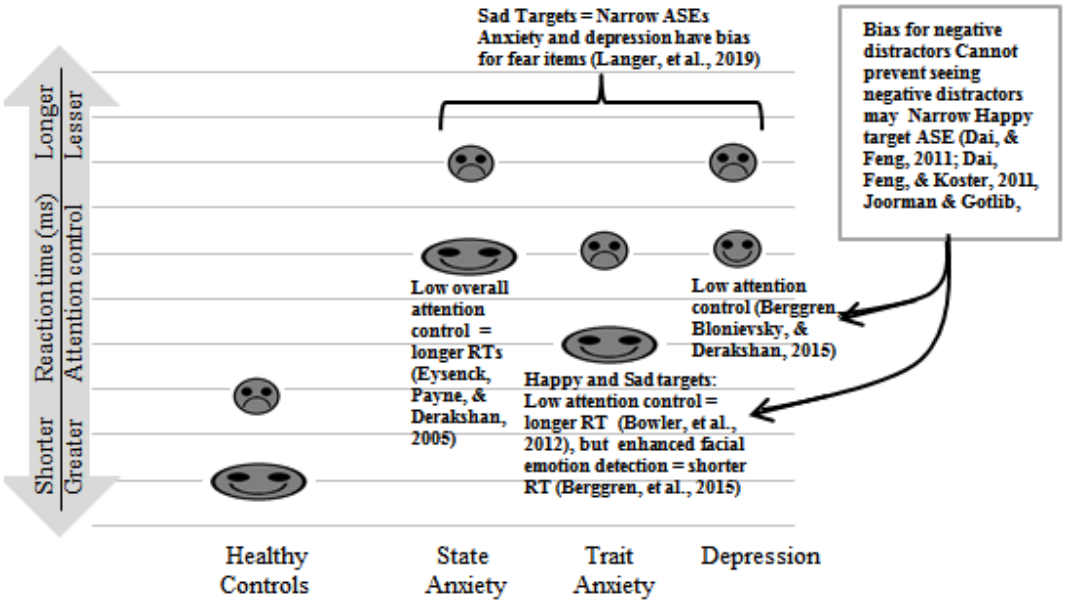


Figure 8. Evidence of Attentional Scope Modulation.
Elongated face (i.e., Broad scope of attention; ASE = Distractors perceived) or round face (i.e., Narrow ASE = Distractors inhibited). Shorter RT = Greater attention control, longer RT less attention control.

Literature-based Attention Control Map

Figure 8 represents the current emotional attention task findings, separated by mood-state. This 'map' of attentional control allows us to form expectations, or predictions, based upon the current findings related to the modulation of the scope of attention in healthy controls, anxiolytics, and depressives (i.e., as attentional control is measured in terms of RT and congruency effects).

Predicting Influence of Reaction Time

Per literature, all groups would be expected to respond more slowly to sad than to happy targets (Anxiety: Eysenck, Derakshan, Santos, & Calvo, 2007, depression: Bodenschatz, et al., 2018). This is exampled in Figure 8 by state, trait and depressions happy and sad faces having longer RTs, or being 'higher in the figure', than the control groups; continued in Figure 9. left).

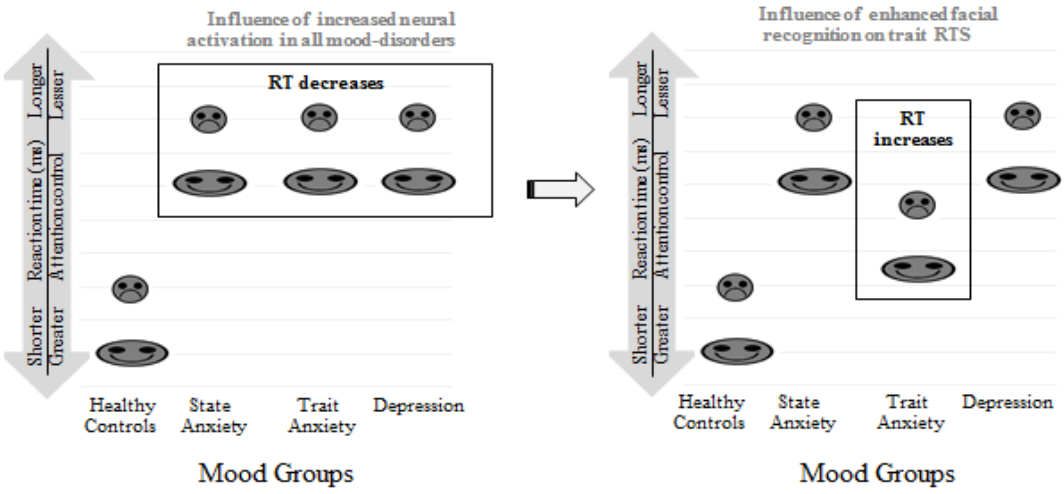


Figure 9. Influences on Mood Reaction Times

Common slow RTs of state, trait and depression (left), and the additional RT changes expected from trait anxiolytics' ability to recognize faces (right). This figure represents the RT differences only. See figure 10 congruency (ASE) variance. Round face= No congruency effect (CE); Narrow ASE, Elongates face= CE; Broad ASE.

Predicting the Influence of Emotional Faces

However, Trait anxiety has an added influence on RT deficits (Figure 9, right) because trait sufferers are more susceptible to recognition of emotional faces. This could evidence in slightly faster trait group RTs (i.e., compared to state or depression); though these RTs would still be slower than for the control group.

Predicting the Influence of Negative Distractors

The scope of attention (i.e., the attentional scope effect; ASE) for state anxiety has been found to be comparable to controls, but depression and trait anxiety have a strong inability to ignore negative distractors. This could result in the ASEs for both depression and trait anxiety to becoming broad to both happy and sad targets and distractors (i.e., to perceive distractors, a broad ASE, with the corresponding congruency effect, is necessary) (Figure 10, A, left, and B middle).

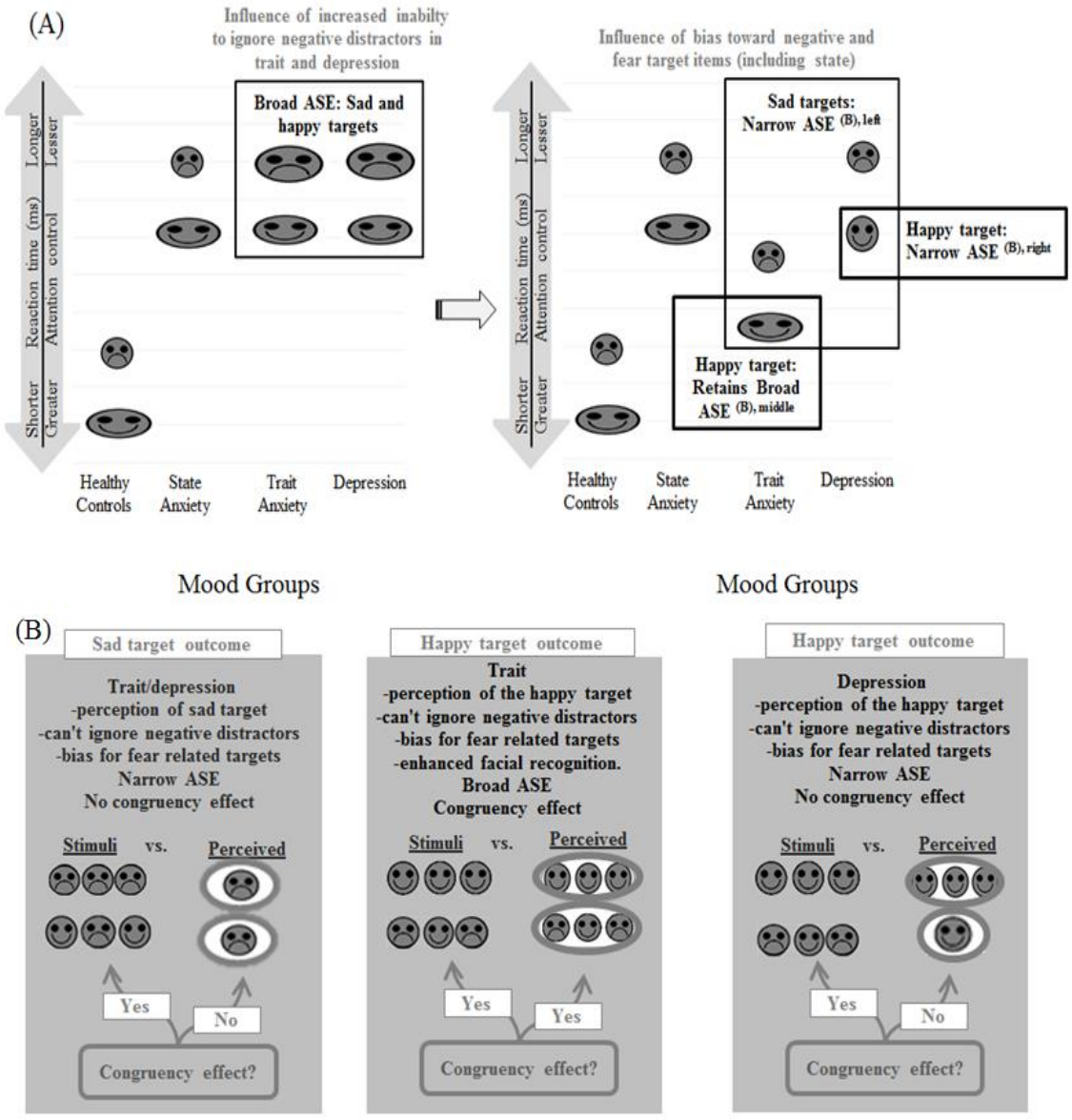


Figure 10. Influences on Mood Congruency Effects.
(A) Common inability to ignore distractors among trait anxiety and depression (left), and the additional congruency changes expected from traits ability to recognize faces (right). (B) The hypothesized perceptual differences between stimuli presented and stimuli perceived during hypothesized ASEs. This figure represents the ASE differences only. See figure 9 for RT variance. Round face= No congruency effect (CE); Narrow ASE, Elongates face= CE; Broad ASE.

But, there is an issue with making a prediction of a broad ASEs for depression and trait anxiety during both happy and sad targets, and distractors:

A broad ASE has only been shown in the flanker task (i.e., used herein) with healthy controls responding to happy targets, not sad. Moreover, we found no flanker-task research showing a broad ASE in response to any negative-type *targets* (i.e., the center, selective focus). However, a broad ASE has been shown with negative *distractors* (i.e., the surrounding emotional stimuli; distractors) (Dai, and Feng, 2011; Dai, Feng, & Koster, 2011). When we add state, trait and depressions bias towards any negative, fear, or danger item, we cold surmise that there may be an interaction between the modulation of the sad targets ASE, a strong inability to ignore negative distractors, and the bias toward negative items. (Figure 10, B).

When assessing this possible prediction, we saw a limiting factor: If sad targets ASEs were to become broadened, they could only achieve this in one instance: sad target congruent (i.e., ☹☹☹; as this is the only condition which has the requisite negative target plus negative distractors). This could pose a problem during the analysis, as *both negative and positive distractor recognition is necessary for a congruency effect* (i.e., ☹☹☹ minus ☺☹☺).

Predicting the Influence of Perceived Negative Emotionality

One last evaluation of a possible sad target, ASE prediction came via the participant's perception of emotional content. Since both anxiety and depression share a bias for sad targets (Bodenschatz, et al., 2018; Eysenck, Derakshan, Santos, & Calvo, 2007) and a bias for fear or danger 'target' items (Langer, et al, 2019), the perceived 'bad-ness' of the sad target may also exert additional force

(i.e., above and beyond that of the normal, healthy fear response) to keep the ASE narrow (Figure 10, right).

For these reasons, we expect that there will be no measurably broad ASE for any mood disorder during presentation of sad targets (i.e., a narrow ASE would be expected for sad targets) (Figure 10, right).

Predicting the Influence of the Happy Target: State Anxiety

As mentioned above, healthy controls and individuals with high state anxiety have been consistently shown to have broad scope to happy targets (Eysenck, Payne, & Derakshan, 2005), but scope of attention for trait anxiolytic individuals is more complicated.

Predicting the Influence of the Happy Target: Trait Anxiety

Individuals with high trait anxiety might be expected to show a broad scope of attention during happy targets due to the inability to ignore negative distractors. If negative surrounding emotions are perceived more than they should be during focus on a happy target (Dai, & Feng, 2011; Dai, Feng, & Koster, 2011), this negative distractor bias would use up attentional resources needed to differentiate between congruent (i.e., ☺☺☺) from incongruent (i.e., ☹☺☹). Therefore, the literature should reflect longer RT to happy incongruent targets, only (i.e., only happy targets with the negative distractors are shown a bias); the literature does not. In this scenario, larger congruency effects would be seen in trait than in healthy individuals, for happy congruencies. But current literature indicates trait anxiolytics to have generally low overall attentional

control (Bowler, et al., 2012) which would shrink congruency effect due to inability to differentiate surrounding distractors.

Another explanation may be that the sad distractor ‘over-emphasis’ activates the scope of attention to narrow in response to the heightened threat of ‘badness’ of the sad distractors. If so, this would result in the scope of attention ignoring ones selective attention to broaden the ASE during happy targets (i.e., the scope of attentions happy-target selective-focus response would be the fear response; narrow), Functionally, if these results were supported, trait anxiolytics would then perceive happy congruent as: ☺☺☺, and happy incongruent as: ☺.

A final interaction in the trait group is that trait anxiolytics have been shown to possess enhanced visual recognition ability for emotional target faces (Berggren, et al., 2015). The target-face emotion has already been shown to impact distractor perception. The enhanced recognition of emotional target faces can be seen as a bias toward positive emotional faces allowing trait-sufferer to accurately discern the emotion of the target faster than healthy individuals. The enhanced recognition of the positive, emotional, happy-face should sustain a broad ASE; allowing perception of the surroundings, salient emotions (i.e., the ‘flankers or distractors).

In sum, we find there is much evidence pointing to a broad ASE for trait anxiolytics during happy target congruencies (i.e., allowing trait anxiolytics to perceive the world the same as healthy controls), therefore, we predict that the trait group will show broad ASEs in happy congruencies (Figure 10, right).

Predicting the Influence of the Happy Target: Depression

The ASE in depression carries low attentional control (Berggren, et al., 2015), like trait and state anxiety (Figure 10, left). However, depression carries the same inability to ignore sad distracting information, as trait (Dai, & Feng, 2011; Dai, Feng, & Koster, 2011), but without the enhanced facial recognition ability of trait anxiety (Figure 10, right). Therefore, happy targets may become overwhelmed by the influence of negative distractors when depressives view salient emotions, thereby producing happy targets with a narrow ASE (i.e., all that would be perceived is a center, happy-faced target) (Figure 10, B).

Predicting the Influence of Distance

Remembering the Attentional Control Theory (ACT), we follow the supposition that better resource utilization means higher attentional control. Therefore, it is clear that the presence of a congruency effect in a near distractor condition would indicate a broadened attentional scope (i.e., the distractors are close to the target and can more easily be noticed or can be less easily ignored). Such a congruency effect would be appropriate and normative for healthy individuals in the happy target condition, but not the sad target condition. But existing theory and research provide much less of a basis for predictions about congruency effects in a far distractor condition. A congruency effect with far distractors would signify an especially broad attentional scope. It is not clear whether this effect is normative in healthy individuals under the happy target condition. The research is lacking. But it would not be inconsistent with ACT.

With regard to sad targets, however, a congruency effect to far distractors would definitely be unexpected in healthy individuals, just as a congruency effect would be unexpected for near distractors. For both near and far distractors, congruency effects to sad targets would indicate an abnormally broadened attentional scope for healthy adults. Since there is little research within the Attention Control Theory (ACT) that concerns congruency and distance, we make no predictions as to how distractor distance might interact with congruency in state, trait or depression (i.e., Figure 10 has no distance distinction made for any group).

The reviewed findings have inconsistencies, but, overall, they suggest that state anxiolytics may be most similar to healthy controls in their processes of attentional control. Also, trait anxiolytics and depressives may share similar attentional deficits. But it remains the case that there are no studies directly comparing the attentional scope of anxiolytics and depressives to healthy controls.

Hypotheses

When comparing the performance of state, trait or depression groups with the performance of healthy controls, Attentional Control Theory (ACT) provides the basis for several key predictions regarding the effects of mood on attentional scope.

The first hypothesis below concerns replication of standard effects previously found in the literature. Such replication is important to establishing that the current sample of participants is typical of samples previously employed, and

helps to establish the external validity of the findings in regards to the hypotheses. Hypotheses 2 and 3 are the novel predictions of the study.

1. Replication of Prior Findings. We hypothesize that the healthy controls will show target effects (i.e., happy will have faster mean RTs than Sad), distance effects (i.e., Near faster than Far) and congruency effects (i.e., Congruent faster than Incongruent). Further, a congruency effect will obtained for happy targets, but not for sad targets. That is, controls will show broad attentional scope effects (i.e., where there is a congruency effect present) during presentation of happy targets in the near, and possibly the far, conditions.

2. Effects of Mood on Attentional Scope.

Healthy controls and state anxiety. We hypothesize that the healthy controls and individuals with high state anxiety will show target effects, distance effects, and congruency effects. Further, the congruency effect will obtain for happy targets but not for sad targets. That is, the control and state anxiety groups will both show broad attentional scope effects (ASEs) during the presentation of happy targets in the near, and possibly the far, conditions. The ASEs may occur more slowly for those with state anxiety than for healthy individuals. Both groups should show a narrowed ASE to sad targets due to the control group's adaptive survival response to fear and states anxiety's bias for sad targets and for fear or danger items (Figure 11).

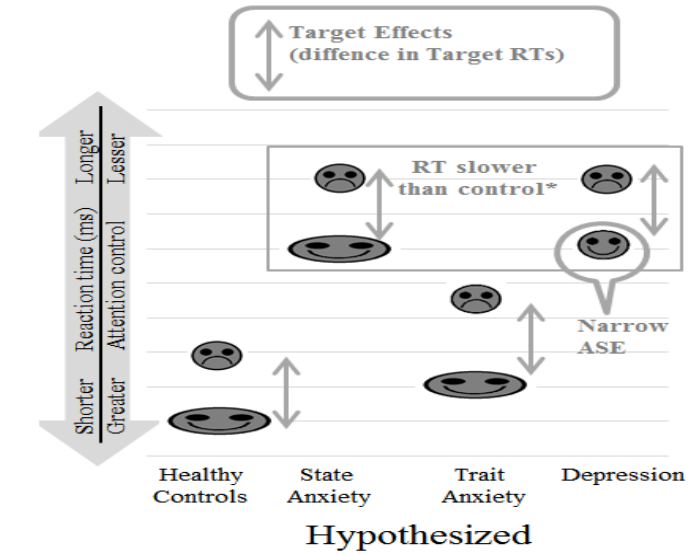


Figure 11. Hypothesized Findings for This Study.
Round face= No congruency effect (CE); Narrow ASE, Elongates face= CE; Broad ASE.

Healthy controls and trait anxiety. We hypothesize that the healthy controls and individuals with high trait anxiety will show target effects, distance effects, and congruency effects. Further, the congruency effect will be obtained for happy targets but not for sad targets. That is, controls and trait anxiolytics will show broad ASEs during presentation of happy targets in the near, and possibly the far, conditions. However, during sad targets, consistently narrow ASEs should be observed due a bias to sad and fear items. We predict that the trait group's lack of attentional control will slow RTs, but their enhanced recognition for faces will result in acceleration of RTs to both happy and sad targets. As a result of these opposing trends, the trait group will not be significantly different

from the control group. The enhanced happy target recognition may help retain a broad ASE, even in the presence of decreased inhibition to negative distractors. RTs for those broad ASEs may be no different than the control group (Figure 11).

Healthy controls and depression. We hypothesize that the healthy controls and those suffering from depression will both show target effects and distance effects, but they will not show the same congruency effects. That is, depressives will show no congruency effect for happy or sad targets due to the increased influence of negative distractors with happy targets and the bias for sad faces and fear items during sad targets. By contrast, controls will show broad ASEs during presentation of happy targets in the near, and possibly the far, conditions, and a narrow ASE to sad targets. Depressions narrow ASEs may be significantly slower than the control groups (Figure 11).

CHAPTER FIVE:

METHODS

Participants

This study included 170 male and female, English speaking university students. These participants were recruited through the SONA: Participant Management System (SONA systems, 2019) (Figure 12 and see Procedure section, Figure 15).

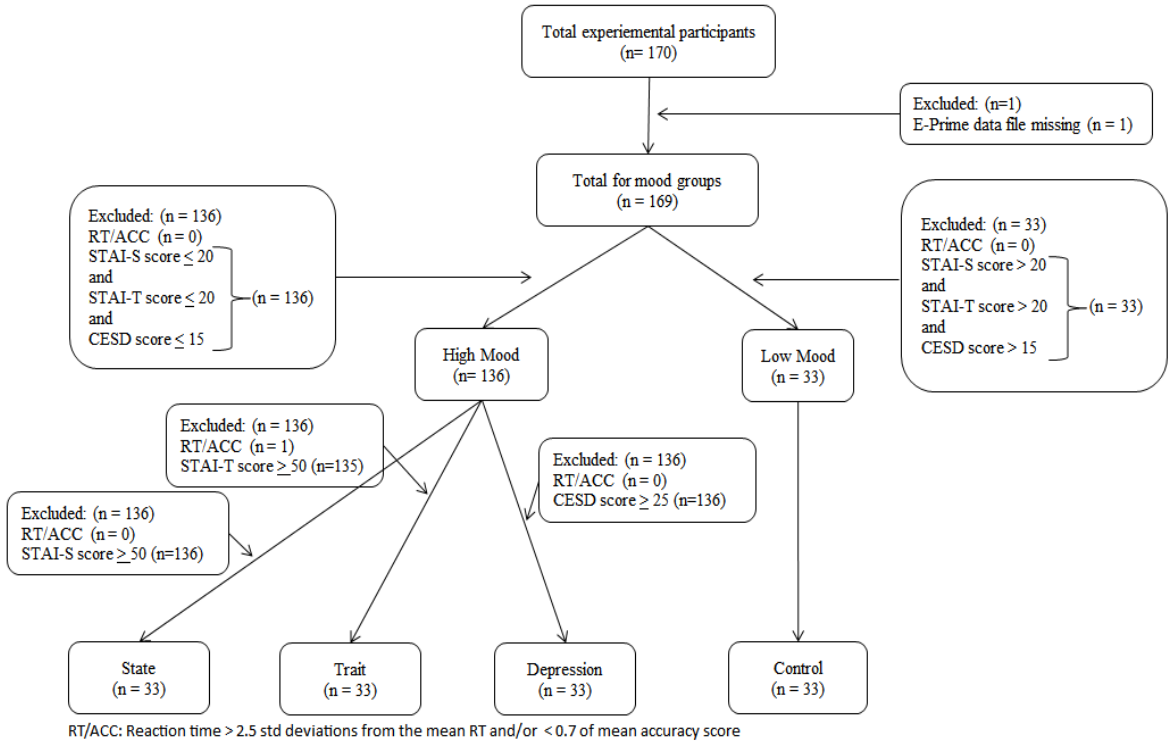


Figure 12. Participant Flow Chart.
Participants (n = 170) completed experiment (i.e., psychological metrics and attention task). Mood groups included Control, State, Trait and Depression (n = 33, respectively). High mood groups included varying degrees of mood comorbidities, Control did not.

The sample was used to create a Control or Healthy Group along with three Mood Disorder Groups – State Anxiety, Trait Anxiety, and Depression. Given the degree of comorbidity typically found for mood disorders, the number of participants in the study was not sufficient to create mutually exclusive groups, and would not be as representative of the current, highly comorbid mood-disorder population data. Thus, the mood disorder groups were not mutually exclusive and the same participant could appear in more than one group. For this reason, the groups were not directly compared in the study.

Participants with reaction times greater than 2.5 standard deviations from the mean and/or accuracy scores lower than 0.7 of the mean were excluded from further analyses. All participants were treated in accordance with the Ethical Principles of Psychologists and the Code of Conduct as established by the American Psychological Association (2013), and authorized under protocols and procedures approved by the Institutional Review Board of California State University, San Bernardino (Appendix A).

Materials

Psychological Metrics.

This study includes several valid, clinical-level measures used in the diagnosis of mood disorders. These measures were used to identify participants whose scores meet the diagnostic criteria for a mood disorder as stated in the Diagnostic and Statistical Manual of Mental Disorders (American Psychological Association, 2013). Such individuals, however, cannot be deemed to have a

clinical level mental disorder solely from the data herein. The diagnostic criteria stated in the DSM include the use of additional measures, such as a differential diagnosis, to rule out other concurrently occurring (co-morbid) or intervening factors. In clinical practice, this differential would assist in identifying the subset of patients presenting symptoms that might be attributable to something other than a mood disorder per se (e.g., the effects of medication, another medical condition, etc.) and would distinguish these individuals from those who do have a mental disorder. The present study does not include the additional medical information required to make a diagnosis of an individual mood disorder. Instead, this study identifies mood disorder scores within the clinical range(s) of an active mental disorder, for statistical purposes. Therefore, this studies' data, in isolation, should not be used as a clinical diagnosis of a mental disorder in any participant(s).

To accomplish mood measurement, participants were instructed to fill out the following clinical-level self-report questionnaires:

Anxiety Measurement - Trait. Trait anxiety (i.e., generalized anxiety symptomology; occurring across many situations) was measured using the State-Trait Anxiety Inventory –Trait anxiety version (STAI-T; Spielberger, 1972; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) (Appendix B). The STAI-T demonstrates reliability in measuring generalized anxious symptomology in university student populations (Cronbach's α = .79 to .93; A Cronbach's alpha internal consistency reliability value of .70 or above indicates good reliability;

Cronbach, 1951) (Bee Seok, Abd Hamid, Mutang, & Ismail, 2018; Grös, Antony, Simms, & McCabe, 2007). Participants responded to 20 questions about how they feel 'in general'. The responses, via computer keyboard, use a Likert scale range of '1' meaning 'almost never', through '4' meaning 'almost always'. Questions addressed mood-state though perception (i.e., 'I feel like a failure'), attention (i.e., '…unimportant thoughts runs through my mind and bothers me'), and behavior (i.e., 'I feel …restless') factors relating to their general, anxiolytic level. The score range was 20 - 80. Test-maker scoring guidelines required reverse coding (i.e., 1, 2, 3, or 4 = 4, 3, 2, 1; For example, a response of 4 would convert to 1, or 2 to 3) of questions 1, 2, 5, 8, 10, 11, 15, 16, 19, & 20 before final scoring. General (Spielberger, 1972), and university-population specific research (Maynard, et al., 2010; Vitasari, et al., 2011) suggests a STAI-T total sub-threshold score of 21-40 is indicative of clinically mild (i.e., inconsequential for short periods), 41-60 is moderate (i.e., consequential for short periods only), or 61-80 is severe (i.e., consequential for any length of time) trait anxiety. All participants not in the control group (See Control Measurement, below) will be placed in a High Mood group. The 33 highest scoring individuals, with a minimum score of 50 on the STAI-T (i.e., regardless of comorbid mood-scores), will be referred to as the Trait group (Figure 12).

Anxiety Measurement - State. State anxiety (i.e., situational anxiety symptomology; occurring during a specific circumstance) was measured using the State-Trait Anxiety Inventory –State anxiety version (STAI-S; Spielberger,

1972; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) (Appendix C). The STAI-S demonstrates reliability in measuring situational anxious symptomology in university student populations (Cronbach's α = .78 to .92) (Bee Seok, Abd Hamid, Mutang, & Ismail, 2018; Grös, Antony, Simms, & McCabe, 2007). Participants responded to 20 questions about how they feel 'right now' or 'at this moment'. The responses, via computer keyboard, use a Likert scale range of '1' meaning 'not at all', through '4' meaning 'very much so'. Questions addressed mood-state through perception (i.e., 'I feel frightened'), attention (i.e., 'I feel confused'), and behavior (i.e., 'I feel jittery') factors relating to their situational, anxiolytic level. The score range was 20 - 80. Test-maker scoring guidelines required reverse coding (See Anxiety Measurement –Trait) of questions 21, 23, 26, 27, 30, 33, 34, 36, & 39 before final scoring. For general and university-population specific research on STAI-S score sub-thresholds totals, see STAI-T. All participants not in the control group (See Control Measurement, below) will be placed in a High Mood group, The 33 highest scoring individuals, with a minimum score of 50 on the STAI-S (i.e., regardless of comorbid mood-scores) will be referred to as the State group (Figure 12).

Depression Measurement. The Center for Epidemiologic Studies Depression scale (CESD; Eaton, Muntaner, Smith, Tien, & Ybarra, 2004; Radloff, 1977) (Appendix D) was used to measure the level of depressive symptomology occurring both at the moment, and in general. The CESD demonstrates excellent reliability in measuring the depressive symptomology of the university student

population (Cronbach's α = .87 to .92; Chang, & Chen, 2018; Jiang, et al., 2019; Shean,& Baldwin, 2008; Umegaki, & Todo, 2017). Participants responded to 20 questions about how they have 'felt or behaved' during 'the past week'. The responses, via computer keyboard, use a Likert scale range of '1' meaning 'rarely, or less than 1 day' (of the past week), through '4' meaning 'most of the time, or 5-7 days'. Questions addressed mood-state though perception (i.e., 'I felt people disliked me'), attention (i.e., 'I had trouble keeping my mind on what I was doing'), and behavior (i.e., 'I talked less than usual') factors relating to their depressive level. The initial score range was 20 - 80. Test-maker scoring guidelines require all responses to have one number subtracted from each question's score (i.e., 1, 2, 3, or 4 = 0, 1, 2, or 3), then, questions 4, 8, 12, and 16 had to be reverse coded (i.e., 0, 1, 2, 3 = 3, 2, 1, 0) before final scoring; making the true range 0-60. General (Radloff, 1977), and university-population specific research (Chang, & Chen, 2018; Jiang, et al., 2019; Shean,& Baldwin, 2008; Umegaki, & Todo, 2017) suggests a CESD total score of 16 or greater is indicative of clinical depression.

The CESD allocates scores at or above 16 to be clinically depressed. The revised scale (CESD-R) allows further depth in categorization of the respondents scoring 16-60. To utilize the CESD-R scoring valances, herein, the CESD participant responses scoring from 16-60 will reflect the sub-threshold CESD-R scoring valances (Figure 13).

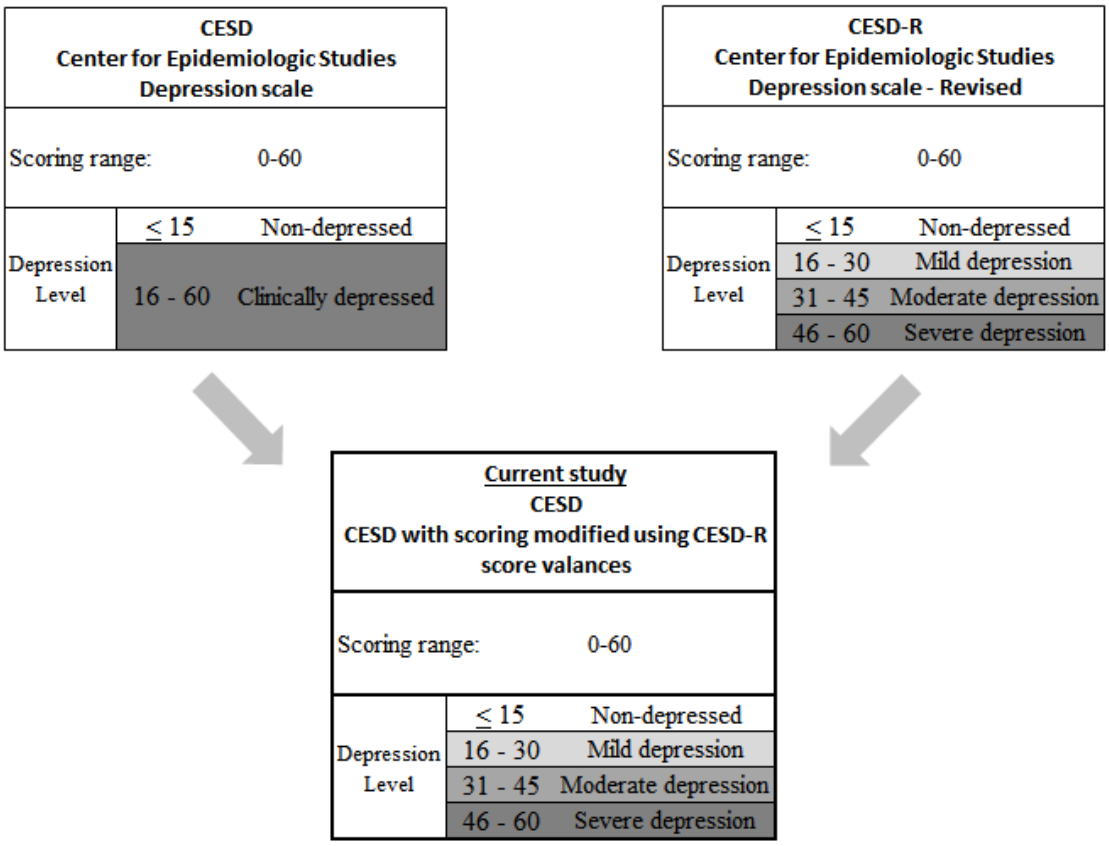


Figure 13. Illustration of CESD Modified Scoring.
The Center for Epidemiological Studies Depression scale (CESD) and the revised scale (CESD-R) modifications. Note: No other score-reporting modifications were made to other psychological metrics used.

All participants not in the control group (See Control Measurement, below) will be placed in a High Mood group, The 33 highest scoring individuals, with a minimum score of 25 on the CESD (i.e., regardless of comorbid mood-scores) will be referred to as the Depression group (Figure 13, bottom).

Control Measurement. Due to the inherent perception of one being 'tested' in a human laboratory experimental environment, some rise in anxiety may be expected in control group participants (Bourne, 2000). Therefore, participants

were assigned to the healthy control group based on three concurrent scores: 30 or less on the STAI-T and 30 or less on the STAI-S and 15 or less on the CESD.

Attention Task

The Emotional Flanker (EF) task is adapted from Barratt, and Bundesen's (2012) experiment 1, and uses emotionally expressive schematic stimuli (i.e., targets: happy-face and sad-face, and distractors: Sad-face, happy-face, neutral-face) to test attentional inhibition (Eriksen, & Eriksen, 1974; Eriksen, & Schultz, 1979) (Figure 14).

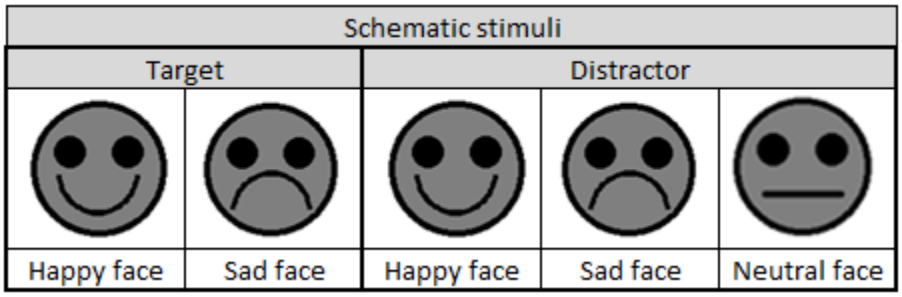


Figure 14. Schematic Emotional Stimuli.
(O'Donnell, 2016).

The task was programmed in E-Prime 3.0 (Psychology Software Tools, 2019), and divided into one practice block comprising 20 trials where participants were instructed to keep accuracy ratings above 95% (i.e., reported back to them in a feedback screen). The EF had 600 main trials, separated into 10 blocks of 60 trials each. Each trial began with a fixation point (i.e., '+') displayed in the center of the screen for 500 milliseconds (ms). The stimulus target (e.g., a

happy-face; ☺, or sad-face; ☹) appeared above the '+' with one of three congruency conditions (CCs). CCs included a horizontal pair of stimuli (e.g., two happy-faces; ☺☺, sad-faces; ☹☹ or neutral faces; 😐😐) surrounding, or 'flanking' the target, with three levels: 'same' as target type (i.e., congruent; ☺☺☺ or ☹☹☹) or 'different' than the target (i.e., incongruent; ☹☺☹ or ☺☹☺) or neither the same nor different than the target type (i.e., neutral; 😐☺😐 or 😐☹😐). The CCs appeared at two distances from the target location: 'close to' the target (i.e., near; ☺☺☺, ☹☺☹, etc.) or 'farther away from the target' (i.e., far; ☺ ☺ ☺, ☹ ☺ ☹, etc.). Participants were instructed to press the 'Z' key with their left hand if the middle face is a sad-face and press the 'M' key with their right hand if the middle face is happy. Neutral face (i.e.,😐) flankers (i.e., 😐☺😐 or 😐☹😐) were also used as a near and far distance CC to evaluate the accuracy of the sad and happy conditions, and to reflect previous literature for healthy controls. However, the participants received no instructions on how to respond to the neutral CC. Response windows auto-terminated at 2000 ms. An interval of 500 ms elapsed between trials. The order of presentation of the trials target, distance and CCs were randomized.

Procedure

The experimental session was in a quiet, laboratory setting. Participants completed an informed consent, and were randomly assigned an anonymous identification code for the experimental session. Next, paper surveys containing demographic information, and mood assessment measures (e.g., STAI-T, CESD,

and STAI-S, in that order) were completed in pen, by participants at a desktop computer workstation. The workstation included a standard keyboard, mouse, 19 inch monitor and 3-sided privacy shields (one situated behind the computer and one covering both the left and right side view-areas of the participant; limiting participant-view to only his/her workstation).After the room-lights were turned off, participants completed the EF computerized task, seated at a viewing distance of approximately 30 inches from the monitor, and were asked to focus their field-of-view on the middle of the monitors screen. The experiment lasted approximately 40 minutes (Figure 15).

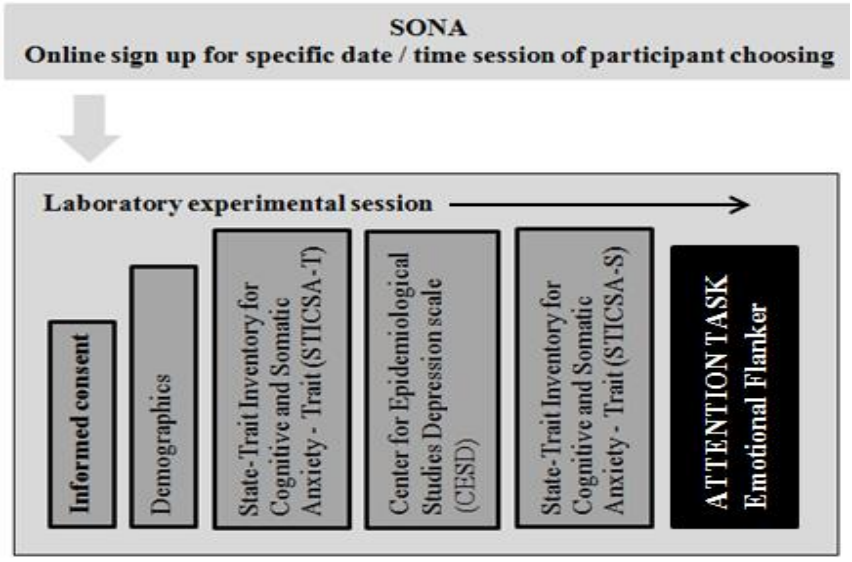
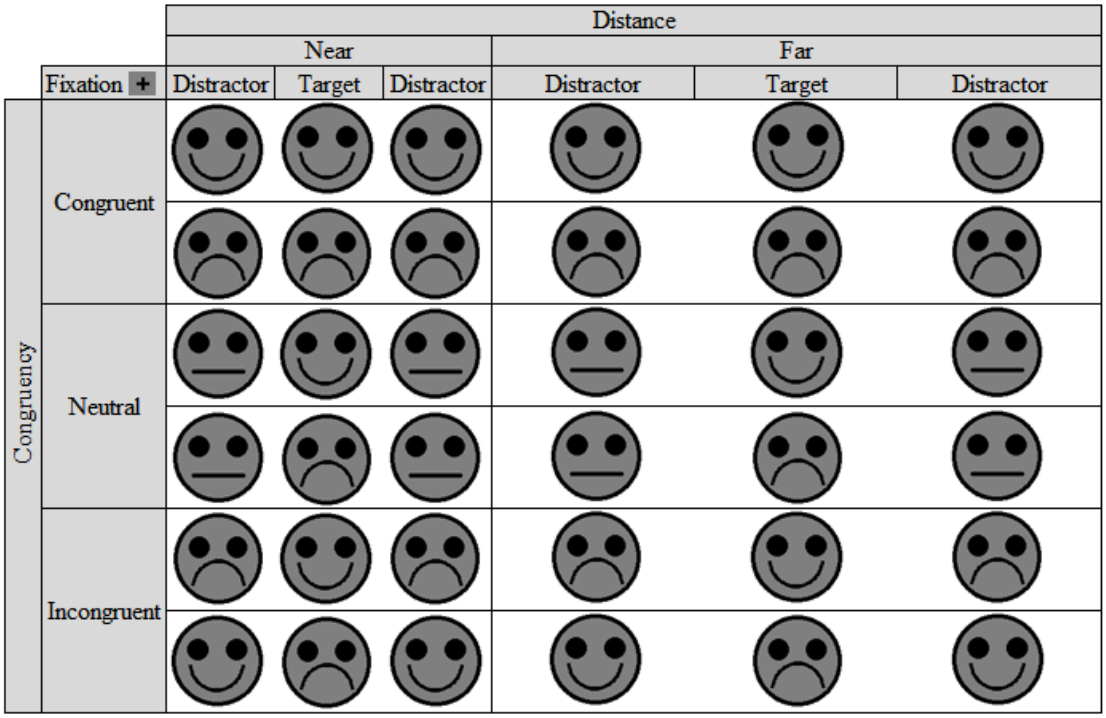


Figure 15. Participant‘s Experimental Progression.
SONA accessed outside laboratory. Laboratory experimental session: 5 minute introduction (by only one a researcher to prevent confounds), participants session number assigned by computer participant randomly chose. After Emotional Flanker completion, experimental session ends with participate logging name on sign-out sheet to receive academic credit.

Design

This study involves a 2 X 2 X 3 repeated measures design. The principle analyses will be within-group in nature. These will consist of repeated measures ANOVAs of Target (happy-face vs. sad-face) by Distance (near vs. far) by Congruency (congruent vs. neutral, vs. incongruent) conducted separately for each of the four groups in the study (e.g., Control, State, Trait, Depression) (Table 2).

Table 2. Independent Variable Stimuli and Conditions.



Targets: Stimuli focused upon and responded to; Happy or Sad.
Distractors or 'Flankers': Faces 'at sides of' or 'surrounding' the target (not focused upon); Happy or Neutral or Sad.
Congruency (of the distractors to the target): The same as (i.e., congruent) , neither the same as nor different than the target (i.e., neutral), or different than the target (i.e., incongruent).

The four groups could not be included in the same analysis because the groups are not mutually exclusive (i.e., some mood groups had participants with comorbidity of high mood disorder scores; Figure 12) (Table 3).

Table 3. Participant Distribution across Mood Groups

Participant Data Distribution					
P data appears across # of mood groups	Mood group(s)	Ps across # of mood groups, by mood group(s)	Total Ps across # of mood groups	% of total Ps, across # of mood groups	Low/High mood group* allocations (n = total Ps used of total Ps available)
One	Control**	33	33	1.00	Low Mood (n = 33 of 33)
	Depression	5	12	0.25	High Mood (n = 48 of 136)
	State	3			
	Trait	4			
Two	Depression and State	7	22	0.46	
	Depression and Triat	7			
	State and Trait	8			
Three	Depression and State and Trait	14	14	0.29	

P =Participant, *Figure 12, **Different Ps than other mood groups

To create the Control group, the lowest scoring participants on the CESD, and STAI-S, and -T (i.e., scoring as having no depression, and no/low state or trait anxiety) were taken from the Low Mood group (n = 33; also see Figure 12). To create the depression, state anxiety, or trait anxiety groups, the highest scoring participants were taken from the High Mood group (n = 33 each group; see Figure 12). For example: Depression had, 'across one mood group' (i.e., depression; Table 3): 5 participants, 'across two groups' (Depression and state = 7, and depression and trait = 7): 14 participants, and 'across three mood groups'

(Depression and state and trait): 14 participants; producing 5 + 14 + 14 = 33 participants in the depression group.

The Dependent variable is a quantitative, continuous variable: reaction times in milliseconds (ms.). The mean score for each of the four groups (control = 558 ms., state = 604 ms., trait = 572 ms., depression = 578 ms.) was also computed (Figure 4).

Table 4. Mood Group Mean Reaction Times

	Mood Groups			
	Control	State	Trait	Depression
RT_{mean}	558	604	572	578

Results

Phase 1 Analysis

These analyses were undertaken to replicate prior effects in the literature with healthy controls so as to establish that the current control sample is comparable to samples previously employed in attention research. Specifically, analyses were intended to replicate standard main effects for target emotionality (happy, sad), distance (near, far), and congruency (congruent, neutral, incongruent) in healthy controls. Millisecond reaction times were analyzed in a repeated measures Analysis of Variance (ANOVA). This 2 x 2 x 3 analysis was

conducted on the control group (i.e., those without clinically depressive or anxiolytic scores).

Phase 1 Results

Results indicated that there were significant target effects ($F_{1, 32}$ = 13.01, p = .001), where happy targets were responded to significantly faster than sad, and significant distance effects ($F_{1, 32}$ = 54.31, p < .001), where near responses were faster than far. In addition, the congruency effect was significant ($F_{1, 32}$ = 20.37, p < .001). Congruent stimuli were responded to faster than incongruent stimuli (Table 3, see table 5 for corresponding means and standard deviations).

Table 5. Control Group 2 X 2 X 3 ANOVA.

Tests of Within-Subjects Effects (Sphericity Assumed)

		Control		
Source	df	F	*Sig.*	η_p^2
Target	1	13.01	*0.00*	*0.29*
Error(Target)	32			
Distance	1	54.31	*0.00*	*0.63*
Error(Distance)	32			
Congruency	2	20.37	*0.00*	*0.39*
Error(Congruency)	64			
Target * Distance	1	3.14	0.09	0.09
Error(Target*Distance)	32			
Target * Congruency	2	26.48	*0.00*	*0.45*
Error(Target*Congruency)	64			
Distance * Congruency	2	4.73	*0.01*	*0.13*
Error(Distance*Congruency)	64			
Target * Distance * Congruency	2	2.42	0.10	0.07
Error(Target*Distance*Congruency)	64			

a. Computed using alpha = .05, η_p^2 = Partial Eta Squared.

These data indicate that the control group correctly identified whether a face was happy or sad and processed the positive or negative emotionality of the

targets differently. The control group also correctly identified whether a distractor face was near to, far from, the same as, or different from the target while processing each change in distance or congruency in a unique fashion. Results indicate that the control group mirrors the trends of publications on emotional target-distractor relationships with /without a distance factor (Figures 16 & 17).

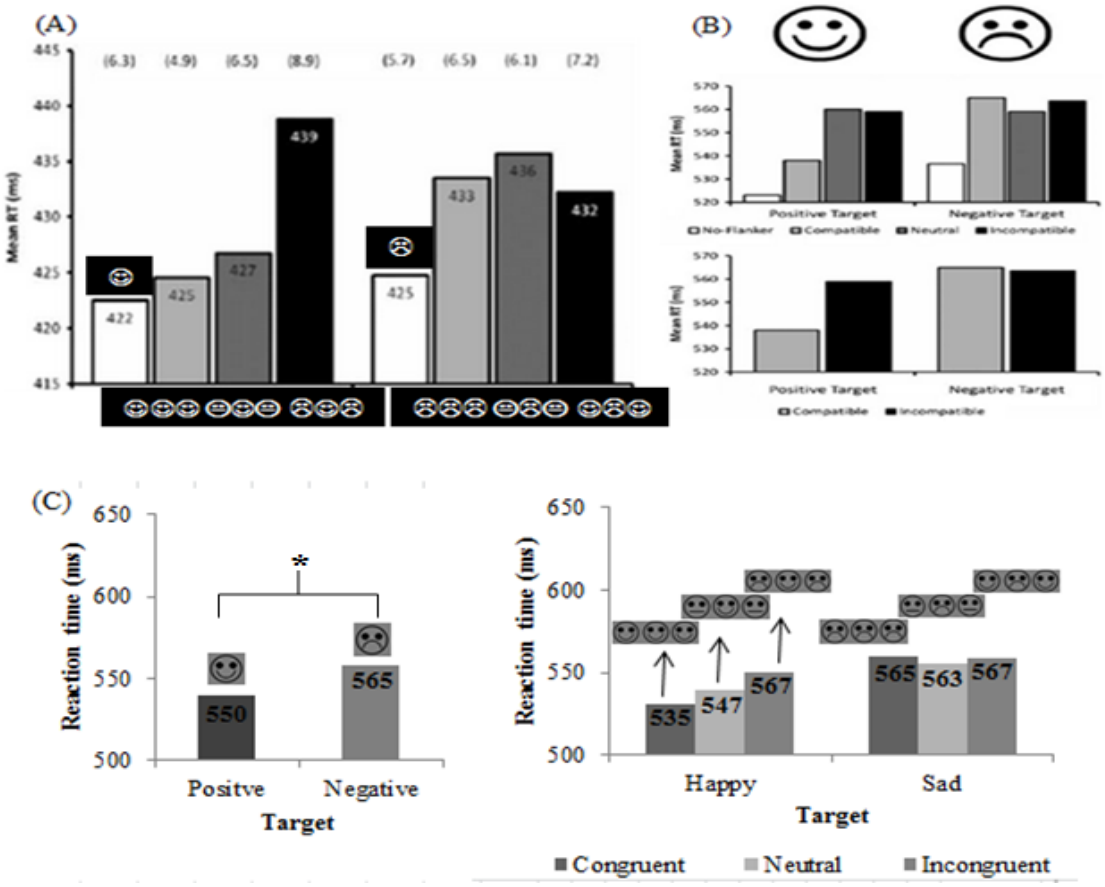


Figure 16. Phase 1 Analysis Results – Target and Congruency
Comparison of present study with prior findings in the literature. Significant target and congruency effects. (A) Barratt and Bundesen (2012) Experiment 1, (B) Fenske, and Eastwood (2003), and (C) Control group data. All RT data show the same trend. Control group: Happy target responses are faster than sad ($F_{1, 32}$ = 13.01, p = .001), and happy congruent is faster than incongruent ($F_{1, 32}$ = 54.31, p < .001), with sad target congruency effects non-significant. Confidence intervals = .95.

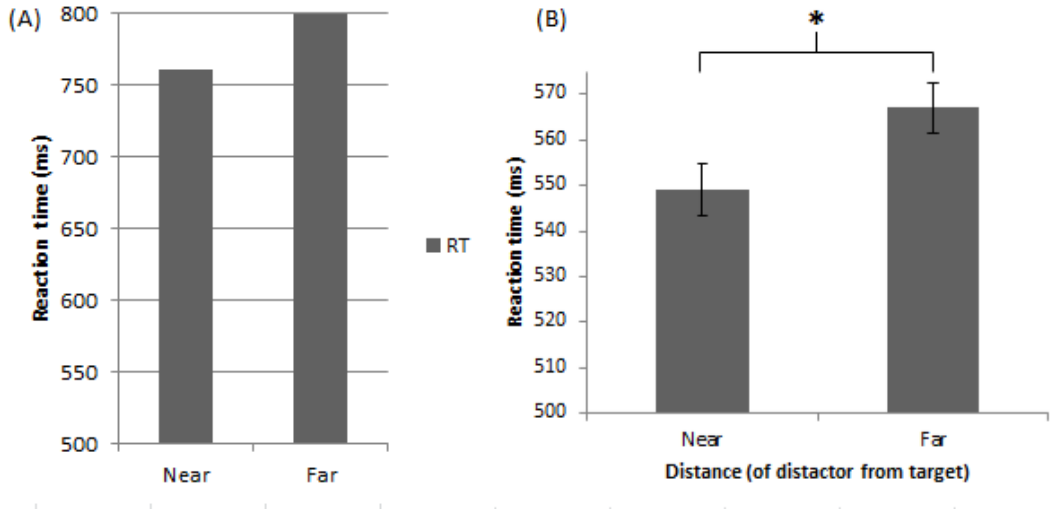


Figure 17. Phase 1 Analysis Results – Distance.
Comparison of present study with prior findings in the literature: distance effects.. (A) Olk, Dinu, Zielinski, & Kopper, (2018) (data illustration); $F_{3, 75} = 15.48$, $p < 0.001$, $\eta_p^2 = 0.382$, and (B) control group data. Both sets of RT data show the same trend. Control group: Near distractor distance from target is associated with faster RT than far ($F = 13.01$, $p = .001$, $\eta_p^2 = .63$). Confidence intervals = .95.

Phase 2 Analysis

In order to test hypotheses 2 and 3, separate, within-group target (happy, sad) by distance (near, far) by congruency (congruent, incongruent) ANOVAs were conducted on participants' mean reaction times for each of the three Mood Disorder Groups (Figure 18).

(A)	Psycological metric mood-score valances			Participant mood-scores (n=170)		
Category	STAI-S	STAI-T	CESD*	State Anxiety	Trait Anxiety	Depression
None	20	20	≤ 15	4	4	98
Mild	21 - 40	22 - 40	16 - 30	93	79	0
Moderate	41 - 60	42 - 60	31 - 45	61	69	52
Servere	61 - 80	62 - 80	46 - 60	12	18	20
*CESD-R score valances used				170	170	170

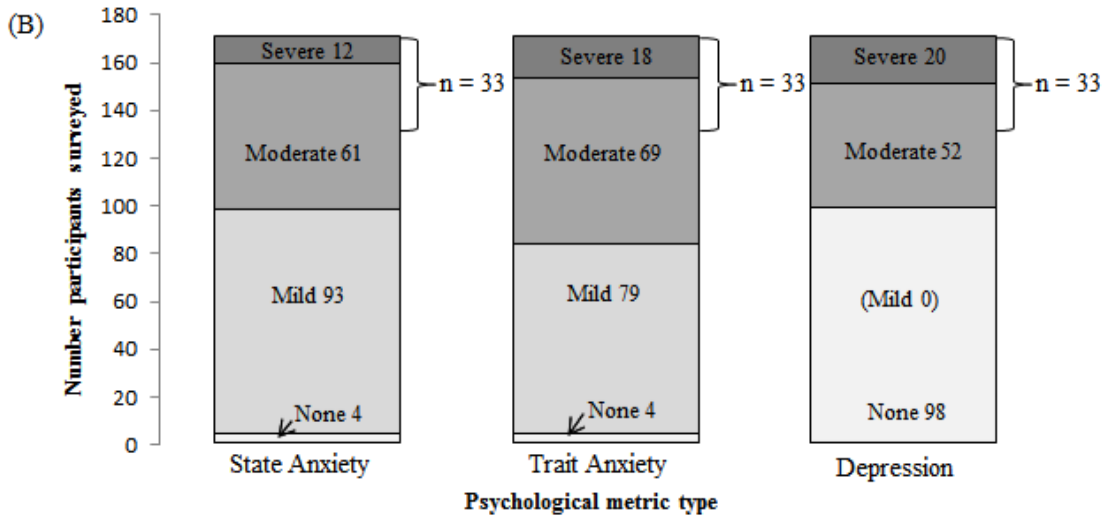


Figure 18. Mood Scores and Mood-group Assignments.
Psychological metric mood score valances and participant response distribution (present study). (A) State-Trait Anxiety Inventory for State and Trait, and Center for Disease Control Depression scale with number of participants who scored in each metrics valance. (B) Histogram of (A) right side. The highest scoring 33 participants per metric were allocated to each mood group.

Phase 2 Results

Between Group Effects

Main effects. ***Target:*** There was a significant target main effect for the control group ($F_{(1, 32)} = 13.07$, $p = .001$, $\eta_p^2 = .29$), but not for the State, Trait or Depression groups (Table 6).

Table 6. Comparison of ANOVAs

Tests of Within-Subjects Effects (Sphericity Assumed)[a, b]		Mood Groups											
		Control			State			Trait			Depression		
Source	df	*F*	*Sig.*	η_p^2	*F*	*Sig.*	η_p^2	*F*	*Sig.*	η_p^2	*F*	*Sig.*	η_p^2
Target	1	*13.01*	*0.001**	*0.29*	0.70	0.410	0.02	0.57	0.457	0.02	0.68	0.414	0.02
Error(Target)	32												
Distance	1	*54.31*	*0.000**	*0.63*	*43.38*	*0.000**	*0.58*	*42.56*	*0.000**	*0.57*	*44.95*	*0.000**	*0.58*
Error(Distance)	32												
Congruency	2	*20.37*	*0.000**	*0.39*	*14.47*	*0.000**	*0.31*	*9.14*	*0.000**	*0.22*	*11.64*	*0.000**	*0.27*
Error(Congruency)	64												
Target * Distance	1	3.14	0.086	0.09	*4.23*	*0.048**	*0.12*	*5.01*	*0.032**	*0.14*	*4.66*	*0.038**	*0.13*
Error(Target*Distance)	32												
Target * Congruency	2	*26.48*	*0.000**	*0.45*	*8.53*	*0.001**	*0.21*	*4.19*	*0.020**	*0.12*	*13.73*	*0.000**	*0.30*
Error(Target*Congruency)	64												
Distance * Congruency	2	*4.73*	*0.012**	*0.13*	*3.42*	*0.039**	*0.10*	*5.22*	*0.008**	*0.14*	*4.59*	*0.014**	*0.13*
Error(Distance*Congruency)	64												
Target * Distance * Congruency	2	2.42	0.097	0.07	1.46	0.239	0.04	0.29	0.753	0.01	0.47	0.625	0.01
Error(Target*Distance*Congruency)	64												

a. Computed using alpha = .05, η_p^2 = Partial Eta Squared, SS = Type III Sum of Squares. MS = Mean Square, Light gray=Effect lost (compared to control).

b. 4 separate 2x2x3 ANOVAs

The control group's mean RT for Happy targets (M = 551 ms) was faster than for Sad targets (*M* = 565; M_{diff} = -14.24). However theses effects were not present in the State, Trait or Depression groups (Figures 7 and 8)

Table 7. Comparison of Means and Standard Deviations

Variable[a]			Mood Group							
			Control		State		Trait		Depression	
Target	Distance	Congruency	M	SD	M	SD	M	SD	M	SD
Happy	Near	Congruent	530	68	580	87	552	76	557	89
		Neutral	539	66	595	103	564	86	565	100
		Incongruent	550	68	600	100	567	74	577	92
	Far	Congruent	541	66	592	94	565	78	567	91
		Neutral	559	73	606	99	574	79	581	94
		Incongruent	585	64	635	94	599	84	606	89
Sad	Near	Congruent	560	62	605	111	570	80	579	97
		Neutral	556	64	593	95	568	85	572	89
		Incongruent	559	58	603	113	568	84	573	95
	Far	Congruent	571	69	612	112	576	83	586	108
		Neutral	570	65	606	103	575	85	580	91
		Incongruent	576	68	618	101	587	85	589	94

Marginal means; RT (ms). M = mean, SD = Standard deviation.

a. 4 separate 2x2x3 ANOVAs

Table 8. Comparison of Effects

		Mood Group															
		Control				State				Trait				Depression			
Effect[a]		*M*	*Mdiff*	*SE*	*Sig.*[b]	*M*	*Mdiff*	*SE*	*Sig.*[b]	*M*	*Mdiff*	*SE*	*Sig.*[b]	*M*	*Mdiff*	*SE*	*Sig.*[b]
Target	Happy	*551*	*-14.424*[*]	*4.00*	*.001*	601	-4.768	5.71	.410	570	-4.035	5.35	.457	576	-4.253	5.14	.414
	Sad	*565*	*14.424*[*]	*4.00*	*.001*	606	4.768	5.71	.410	574	4.035	5.35	.457	580	4.253	5.14	.414
Distance	Near	*549*	*-17.778*[*]	*2.41*	*.000*	*596*	*-15.212*[*]	*2.31*	*.000*	*565*	*-14.409*[*]	*2.21*	*.000*	*570*	*-14.343*[*]	*2.14*	*.000*
	Far	*567*	*17.778*[*]	*2.41*	*.000*	*611*	*15.212*[*]	*2.31*	*.000*	*579*	*14.409*[*]	*2.21*	*.000*	*585*	*14.343*[*]	*2.14*	*.000*
Congruency	C-Nu	*551*	*-5.652*[*]	*2.37*	*.023*	597	-3.000	2.81	.294	566	-4.409	3.49	.215	572	-2.402	2.84	.404
	Nu-C	*556*	*5.652*[*]	*2.37*	*.023*	600	3.000	2.81	.294	570	4.409	3.49	.215	575	2.402	2.84	.404
	Nu-I		*-11.242*[*]	*2.69*	*.000*		*-13.720*[*]	*3.33*	*.000*		*-10.280*[*]	*3.18*	*.003*		*-11.439*[*]	*2.78*	*.000*
	I-Nu		*11.242*[*]	*2.69*	*.000*		*13.720*[*]	*3.33*	*.000*		*10.280*[*]	*3.18*	*.003*		*11.439*[*]	*2.78*	*.000*
	C-I		*-16.894*[*]	*2.99*	*.000*		*-16.720*[*]	*3.74*	*.000*		*-14.689*[*]	*3.87*	*.001*		*-13.841*[*]	*3.52*	*.000*
	I-C	*568*	*16.894*[*]	*2.99*	*.000*	*614*	*16.720*[*]	*3.74*	*.000*	*580*	*14.689*[*]	*3.87*	*.001*	*586*	*13.841*[*]	*3.52*	*.000*

Based on estimated marginal means; RT (ms). M = Mean, Mdiff = Mean difference, SE = Standard Error

*. The mean difference is significant at the .05 level. C = Congruent, Nu = Neutral, I = Incongruent. Light gray indicates effect lost (compared to control).

a. 4 separate 2x2x3 ANOVAs

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Data from these within-group analyses (Figure 6) also suggest that RTs were generally longer to both happy and sad targets in these groups compared with the control group (Figures 7 and 8). To test whether the within group condition RTs of control were significantly shorter than those of state, trait or depression; we compared the conditional means of the control group to the other three groups, using a student's t-test (Table 9).

Table 9. Comparison of Conditions for Control vs. State, Trait, or Depression.

			Mood Group															
Condition			Control+ vs.			State				Trait				Depression				
Target	Distance	Congruency	M	SD		M	SD	$t_{(65)\ C,S}$	p	M	SD	$t_{(65)\ C,T}$	p	M	SD	$t_{(65)\ C,D}$	p
Happy	Near	Congruent	530	68		580	87	*2.34*	*0.022**	552	76	1.33	0.188	557	89	1.39	0.169
		Incongruent	550	68		600	100	*2.39*	*0.020**	567	74	0.78	0.440	577	92	1.14	0.257
	Far	Congruent	541	66		592	94	*2.48*	*0.016**	565	78	1.09	0.280	567	91	1.48	0.144
		Incongruent	585	64		635	94	*2.16*	*0.034**	599	84	0.98	0.332	606	89	1.44	0.155
Sad	Near	Congruent	560	62		605	111	1.71	0.091	570	80	0.24	0.815	579	97	0.71	0.480
		Incongruent	559	58		603	113	1.94	0.057	568	84	0.60	0.554	573	95	0.67	0.506
	Far	Congruent	571	69		612	112	*2.03*	*0.046**	576	83	0.57	0.569	586	108	0.94	0.351
		Incongruent	576	68		618	101	1.89	0.063	587	85	0.48	0.631	589	94	0.73	0.468

+ vs. State (S) or Trait (T) or Depression (D), M=Mean RT, SD=Standard deviation, t=students t-test, *p ≤ .05.
Light gray indicates a single condition with a broad ASE (i.e., cannot be calculated by incongruent minus congruent).

Results (Table 9) confirmed that the state group's RTs (M = were significantly slower than the control group for happy targets when near (Congruent: $t_{(65)}$ = 2.34, p = .022; ☺☺☺, Incongruent: $t_{(65)}$ = 2.39, p = .020; ☹☺☹), and when far (Congruent: $t_{(65)}$ = 2.48, p = .016; ☺ ☺ ☺, Incongruent: $t_{(65)}$ = 2.16, p = .034; ☹ ☺ ☹). When the state group viewed sad targets, they were also significantly slower than control in response to far congruent distractors ($t_{(65)}$ = 2.03, p = .046; ☹ ☹ ☹). However, no other sad conditions for state, or any happy or sad

condition for trait or depression groups differed from the control group significantly.

These results indicate that while the groups were able to correctly identify whether a face was happy or sad, the high state anxiety group was affected by both the positive and the negative emotionality of the target to a greater extent than controls (Figures 7 and 8). Since RTs were greater to happy and sad targets in the high state anxiety group compared to controls, it seems that this group was affected by emotionality to a greater degree than the controls. They did not show a Target effect (i.e., state were not more significantly affected by negative than positive targets). The controls were more affected by negative than by positive targets (Tables 7 and 8).

Distance: There was a significant difference between near and far distance conditions for the Control ($F_{(1, 32)} = 54.31$, $p < .001$, $\eta_p^2 = .63$), State ($F_{(1, 32)} = 43.38$, $p < .001$, $\eta_p^2 = .58$), Trait ($F_{(1, 32)} = 42.56$, $p < .001$, $\eta_p^2 = .57$), and Depression ($F_{(1, 32)} = 44.95$, $p < .001$, $\eta_p^2 = .58$) groups (Table 4). RTs for distractors in the Near position were faster than in the Far position for the Control (Near: M =549, Far: M = 567, M_{diff} = -17.78), State (Near: M = 596, Far: M = 611, M_{diff} = -15.21), Trait (Near: M = 565, Far: M = 579, M_{diff} = -14.41), and Depression (Near: M = 570, Far: M = 585, M_{diff} = -14.34) groups. These data indicate that State, Trait and Depression groups were able to correctly identify whether a distractor face was close to or far from the target face. They processed the distance locations uniquely, mirroring the Control group (Tables 7 and 8).

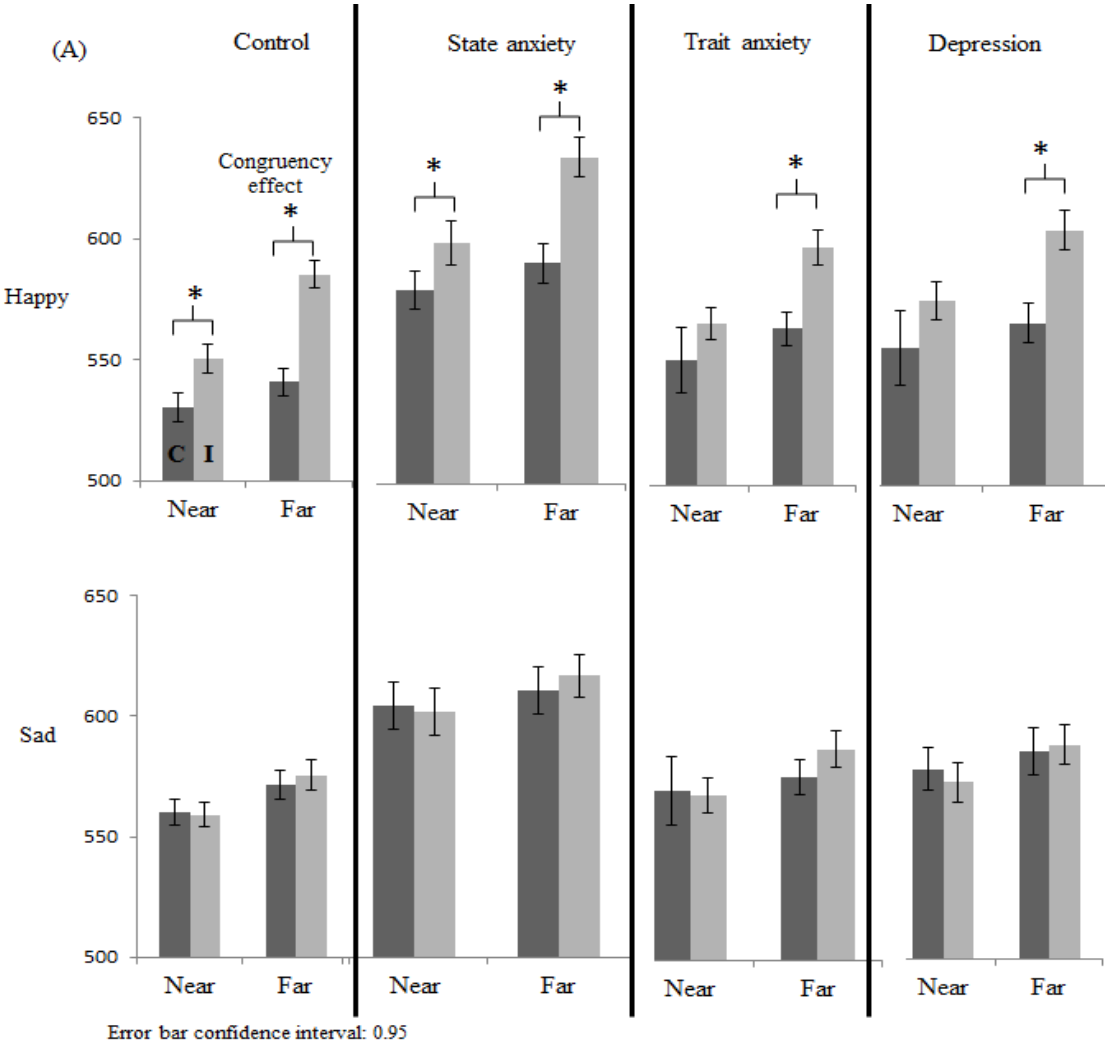
Congruency: There was a significant Congruency effect in RTs for the Control ($F_{(2, 64)}$ = 20.37, p < .001, η_p^2 = .39), State ($F_{(2, 64)}$ = 14.47, p < .001, η_p^2 = .31), Trait ($F_{(2, 64)}$ = 9.14, p < .001, η_p^2 = .22), and Depression ($F_{(2, 64)}$ = 11.64, p < .001, η_p^2 = .27) groups (Table 4). In the Control group, RTs when distractors were Congruent (M = 551) with the target were faster than when distractors were Neutral (M = 556; M_{diff} = -5.65) or Incongruent (M = 568, M_{diff} = -16.89), and RTs for the Neutral condition were faster than for Incongruent (M_{diff} = -11.24) condition. In State, Trait and Depression groups, there were no significant differences between the Congruent and Neutral conditions. But RTs to Congruent trials were faster than RTs to Incongruent trials in State (Congruent: M = 597, Incongruent: M = 614, M_{diff} = -16.72), Trait (Congruent: M = 566, Incongruent: M = 580, , M_{diff} = -14.69), and Depression (Congruent: M = 572, Incongruent: M = 586, , M_{diff} = -13.84) groups. In addition, RTs were faster under the Neutral condition than the Incongruent condition for State (Neutral: M = 600, M_{diff} = -13.72), Trait (Neutral: M = 570, M_{diff} = -10.28), and Depression (Neutral: M = 575, M_{diff} = -11.44) groups. These data indicate that, comparable to healthy participants, State, Trait and Depression groups distinguished between congruent and incongruent conditions. However, unlike the healthy participants, these groups were not sensitive to the distinction between congruent and neutral conditions (Tables 7 and 8).

Interactions of Congruency with Distance and Target

To determine whether scope of attention varied by type of target (i.e., happy or sad) or degree of distance (i.e., near or far), the interactions between congruency, distance, and target emotionality were considered. Again, congruency effects are broad Attentional Scope Effects (ASE), and no congruency effect is a narrow ASE. ASE types are categorize as : advantageous, when they are the same as the control group, for that condition, or effect, or disadvantageous if different than the control group.

Results indicated that the control and state groups showed a broad ASE (i.e., a congruency effect) for both near and far conditions with happy targets. Trait and depression, however, showed a narrow ASE (i.e., no congruency effect) in the near condition with happy targets and a broad ASE in the far condition with happy targets. All groups showed a narrow ASE when viewing Sad targets at any distance, except for state anxiety in the sad, far, and congruent condition, when compared to the control group (Table 9) (See Effects of Mood on Attentional Scope, Healthy Controls and State Anxiety, para. 2)

These data show the state, trait and depression groups have the ability to perceive the same amount of stimuli as the control group when viewing negative items, at any distance, and when viewing positive items from afar. But when focusing on near, happy items, trait and depression perceive significantly less stimuli than the Control group (Figure 19).



(B)

	Happy		Sad	
	Near	Far	Near	Far
Control	Broad	Broad	Narrow	Narrow
State anxiety*	Broad*	Broad*	Narrow	Narrow*
Trait anxiety	Narrow	Broad	Narrow	Narrow
Depression	Narrow	Broad	Narrow	Narrow

*Mean RT sig. longer than control in one or more congruency condition via students t-test; $p \leq .05$

Figure 19. Mood Group Congruency and Attentional Scope Effects by Distance. (A) Congruency effects (CE; significant difference marked with '*' between C; congruent = dark grey, and I; incongruent = light gray) per mood group for Near or Far. Broad ASE = CE, Narrow ASE = No CE. (B) Attentional scope effects. Congruency effect and RT variance with control group compared to either state, trait or depression group. Data from Table 4, 7 & 8; confidence intervals = .95.

CHAPTER SIX:

DISCUSSION

The measurement of congruency effects, in the near and far locations, allowed us to evaluate the scope of attention for those with and without clinical mood symptomology. All groups showed a narrowed ASE (scope of attention) with sad targets regardless of whether distractors were in close proximity to the target or were relatively distant from the target. Thus, when viewing negative targets, the state, trait and depression groups demonstrated the same narrowed scope of attention as the control group, and this was the case regardless of the distracter location.

When viewing positive targets, we found that the scope of attention for the state group was broad, like the control group. But in trait and depression, the scope of attention was narrow (Figure 20).

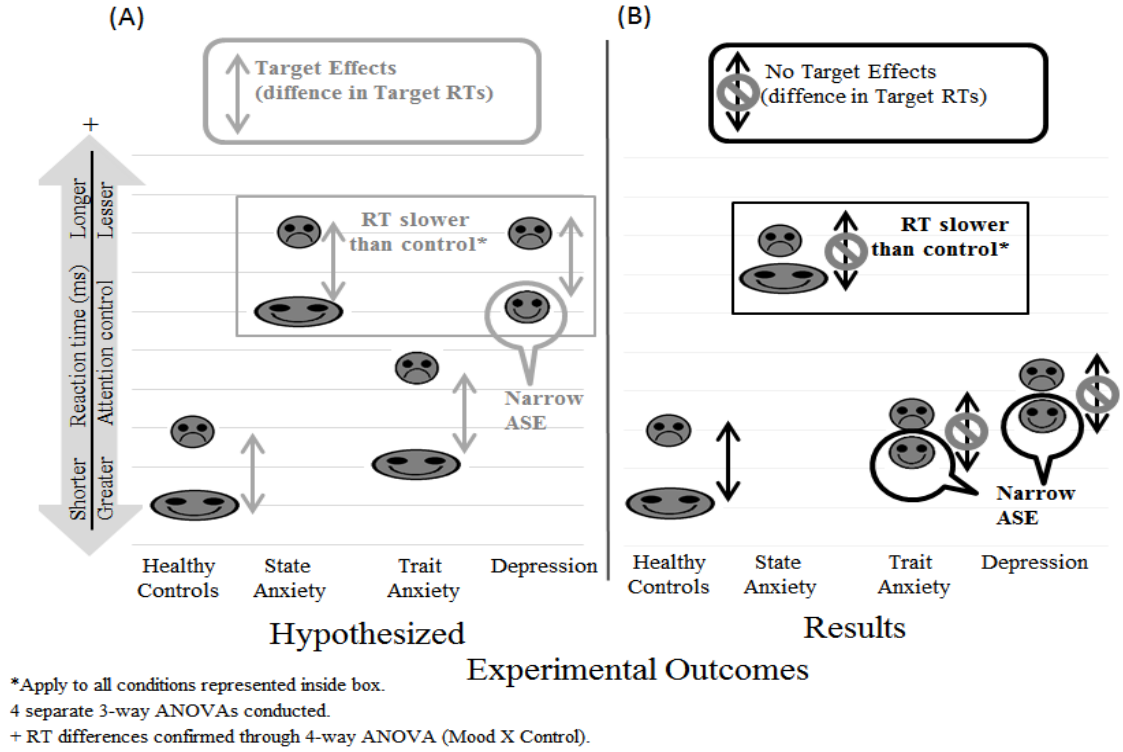


Figure 20. Hypothesized Compared to Experimental Outcomes. (A) Hypothesized results per literary findings (Reprint: Figure 9). (B) Experimental results. State: Prolonged RT to emotional stimuli, no ASE difference to control group, but loss of target effect. Trait and depression: No RT difference to emotional stimuli, but ASE narrow to happy targets and loss of target effect. ASE: Attentional Scope Effect, ☺ = Happy or ☹ = Sad target, elongated face = broad ASE, round face = narrow ASE.

We utilized the distance variable to plot the near and far congruencies within each mood group, then examined the distances with a congruency effect (i.e., a broad Attentional Scope Effect; ASE), and those without a congruency effect (i.e., a narrow ASE) (Figure 21).

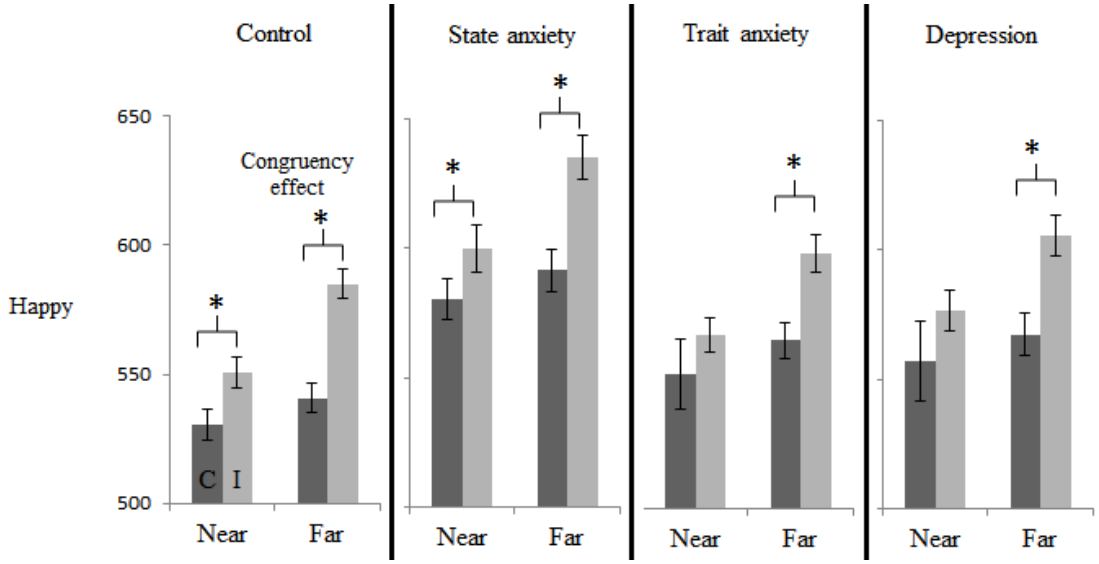


Figure 21. Comparison of Mood Group Congruency by Distance. Happy target only, *CE: I = Incongruent minus C = Congruent.

The state, trait and depression groups' ASEs were comparable to those for the control group when the distractors were in the far location (i.e., Broad ASEs are reflected in a congruency effect at that distance location). However, when distractors were in close proximity to a positive target, the control and state groups showed a broad attentional scope while the trait and depression groups showed a narrowed attentional scope (Figure 21). Thus, the state group does not differ from the control group in terms of attentional scope (i.e., the state and control groups show a congruency effect to positive targets and no congruency effect to sad targets, regardless of the distractors' degree of proximity to the target). Therefore, the same amount of emotional information is entering perception for state anxiolytics and health controls.

By contrast, the trait and depression groups differ from the control and state groups in their ASE response to happy targets when distractors are in close

proximity to the target. Therefore, although the trait and depression groups mirror the control and state groups narrow ASEs when sad targets distractors are at any proximity to the target, and mirror broad ASEs to happy targets when distractors are far from the target, once the target is happy, and near, the trait and depression groups show a narrow ASE (Figure 21). Said differently, when salient-emotions are geographically close to positive stimuli, trait and depression show no congruency effect. Therefore, a different amount of emotional information (i.e., less data) is entering the perception of trait anxiety and depressives than state anxiety or healthy controls (Figure 22).

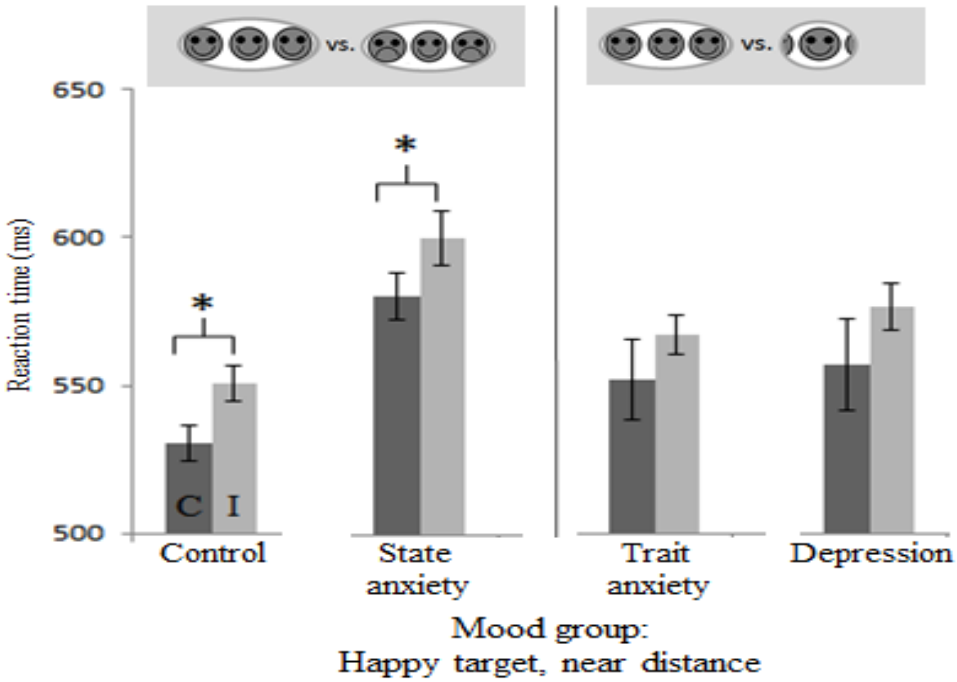


Figure 22. Comparison of Mood-group Perception – Happy, Near.
Trait and depression perceive less emotional stimuli during happy targets with nearby, salient emotional stimuli than healthy controls or state anxiolytics. Top faces = salient emotions perceived, C = congruent, I = incongruent. *Congruency effect (CE) = broad ASE. No CE = Narrow ASE.

Why is it that high trait individuals and depressives show no congruency effect to happy targets under the near distractor condition but do show a congruency effect to happy faces under the far distractor condition? This is a more complicated question. First, in evaluating the far condition, the presence of a Broad ASE in the happy targets far distractor condition seems to reflect that those with trait anxiety and depression have a decreased capacity to inhibit processing of non-adjacent irrelevant information (i.e., one can't help but see the far distractors) (Rowe, Hirsh, & Anderson, 2007). This simply indicates that depressives and trait anxiolytics are like healthy controls in having a broad attentional scope to happy stimuli, and can identify the emotionality of the changing distractors when they are at a distance from their focus. (i.e., they can correctly evaluate non-focused-upon' emotional information). This allows the evaluation of many items in the environment; an advantage when approaching other humans. Second, the presence of a Narrow ASE in the happy target, near condition could reflect an increased capacity to inhibit processing of spatially adjacent irrelevant information. But why would depressive and trait anxiolytics have greater inhibitory capabilities than health controls? It may be that these mood disorders involve some kind of difficulty with controlling attention to emotionally salient targets when distractors of any kind are in close proximity. This would constitute a lack of control over attentional processes when emotion is involved. Whether the target is happy or sad, these individuals may tend to narrow their focus when distractors are in close proximity to the target. This is

supported by the loss of target effects for trait anxiety and depression seen in Table 6. This could be a reaction to being over stimulated (i.e., overexertion of the normal cyclical, repetitive mechanisms of thought) by the emotionality of multiple closely-spaced targets (i.e., making the issue an inability to process any emotional stimuli when near, not an issue with a specific emotion, or emotional salience).

Prediction versus Outcome

Replication of Previous Findings

Our first hypothesis concerned the replication of standard effects previously found in the literature. This successful replication established the current sample of control group participants to be typical of samples previously employed in the literature. Therefore, we established the external validity of the following findings: healthy controls showed target effects (i.e., happy had faster mean RTs than sad), distance effects (i.e., near was responded to faster than far) and congruency effects (i.e., congruent was responded to faster than Incongruent). Additionally, a congruency effect was present for happy targets, but not for sad targets, such that the control group showed broad attentional scope effects (ASE; i.e., where there is a congruency effect present) during presentation of happy targets in the near condition. We had presented an additional, conditional hypothesis, that we may see broad ASEs in the happy target, far condition. Although there is less previous research on the distance by congruency interaction, the available findings are consistent with the presence of

a congruency effect. Indeed we found congruency effects in the happy far condition. These findings support our assertion that the control group is representative of the larger, healthy population.

Effects of Mood on Attentional Scope

Healthy Controls and State Anxiety. We hypothesized that the healthy controls and state anxiety would show target effects, distance effects, and congruency effects. Distance and congruency effects were found in state anxiety, but target effects were not present (Table 6). This unexpected loss of emotional differentiation and its effect on the ASE, will be expanded upon below (see Loss of the Target Effect). We hypothesized that there would be a congruency effect for happy targets but not for sad targets. That is, controls and state would show broad ASEs during presentation of happy targets in the near, and possibly far conditions, but those ASEs may be significantly slower than the control groups.

These expected congruency effects were confirmed for both sad and happy targets in both the near and far conditions. RTs to happy targets with distractors in the near and far conditions occurred significantly slower than for the control group (Figure 19). Response to sad targets with congruent distractors, at the far distance (i.e., ☹ ☹ ☹), were also significantly slower than the control group (Table 9). Congruent sad is the most negative condition, used herein, and no other such significant results were found for trait or depression (when compared to control). Therefore, these data suggests that state sufferers are highly biased toward negative or fear items (Table 9).

Healthy Controls and Trait Anxiety. We hypothesized that the healthy controls and trait anxiety groups would show target effects, distance effects, and congruency effects. Distance and congruency effects were found in trait anxiety, but target effects were not (See Loss of the Target Effect) (Table 6). Congruency effects were hypothesized to be obtained for happy targets but not for sad targets. That is, it was expected that controls and trait anxiolytics would show broad ASEs during presentation of happy targets in the near, and possibly the far, conditions.

Congruency effects for sad targets, at any distance, and for happy targets at the far distractor-distance, were confirmed. However, predictions for the trait group's response to happy targets in the near location were not confirmed (Figure 19). We reasoned that the trait group's enhanced recognition for faces would result in the retention of a broad ASE even in the presence of decreased inhibition to negative distractors. However, we were incorrect in our assertion. It seems that the reduced inhibition to negative distractors for those who experience trait anxiety is a stronger influence on the modulation of the ASE than enhanced recognition for faces. Another intervening factor could be that the enhanced recognition for emotional faces is stronger for sad than happy faces, leaving, happy targets to be overwhelmed by negative emotional distractions. Additionally, we predicted that the RT for those ASEs would be no different than the control groups; this was confirmed by the data (Table 9).

Healthy Controls and Depression. We hypothesized that the healthy controls and the depression group would show target effects and distance effects, but would differ in regard to congruency effects. Distance effects were found for the depressives, but not target effects (see Loss of the Target Effect) (Table 6). In addition, and as predicted, the groups showed different congruency effects. That is, no congruency effects were expected in the depression group for happy targets or for sad targets, and, with the exception of happy targets in the far condition, none were found. It had been hypothesized that depression would result in a narrow ASE in near and possibly far conditions due to the inability to inhibit negative distractors. This was confirmed to be true. The RTs to happy and sad targets were also hypothesized to be significantly slower than for the control group. However, this was not the case (Table 9). This may be explained by the fact that a narrow ASE for depressives equated to 'perceiving no distractors' or 'perceiving the target only'.

Effect Loss

Loss of Targets Effect. Loss of target effects were found in the state anxiety, trait anxiety, and depression groups (Table 6). Target effects are an inherent human survival mechanism which are evident in RT differences between responding to a positive or a negative emotional target (i.e., happy faces are responded to faster than sad faces in healthy individuals). Therefore, loss of a target-effect is essentially a reduction in the ability to distinguish emotional stimuli. Loss of target effects illustrates that the brain's emotional processing

centers (i.e., ACC/MCC) are unable to formulate unique, emotion-related, responses. However, each participant in the state, trait and depression groups correctly identified whether a target face was happy or sad (i.e., each subject's accuracy score was no less than 30% below the mean accuracy score of that condition). This data shows evidence that the state, trait and depression subjects' brains have the ability to perceive whether a target is exhibiting the emotions of happy or sad. Therefore, at least a portion of the brains emotional processing centers are working in state, trait and depression groups.

Loss of the Distractor's Effect. Distinction of distractors plays an integral part in the measurement of the ASE. Distractor differentiation is seen in the congruency effect (see Table 6, Congruency row for congruency per mood group and Figures 21 and 22 for distractors loss per mood group). In the case of un-perceived distractors, the mind does not place them into memory (Heurley, & Ferrier, 2015; Martin, 1992; Mitterer, Horschig, Müsseler, & Majid, 2009).

Therefore, these data reveal that trait anxiolytics and depressives' perception of the emotional-world (i.e., their 'map-of-life' or their overall experience of the moment) is significantly different than those in the control group and state anxiety group (Figure 22). This suggests that small group social interaction, which occurs in almost every moment of work, school, or home life, would have missing data for trait anxiolytics and depressives; data which healthy brains readily perceive.

This missing data would pertain to any emotional content that is not in one's specific focus, at a given moment. Evaluating the emotional saliency of a group has been hard-wired into the human brain, Therefore, the exclusion of group emotional dynamics alters the assessment of the human environment, the perception of one's future in that environment, and the way humans perceive ongoing human emotional-interactions. In short, the loss of perception of emotional distractors alters the human experience and expectations of our ongoing emotional-place in society.

Loss of the Attentional Scope's Effect. Happy emotionally-salient encounters tend to intensify at close range (i.e., when other humans are near). 'Near' interactions are found in most interpersonal settings (i.e., at work, with friends), and it is these interactions that would be the most necessary to build/maintain positive social-emotional effects both in society and in the individual. However, Trait and Depression showed a narrowed ASE in response to positive stimuli with near distractors (Figure 21 and 22). This would indicate that those with Trait anxiety or Depression could not accurately distinguish the current group's emotional changes. Without the ability to process small group interactions, a human would be unable to adapt to social changes.

Implications of the Mood Driven Attentional Scope

Perceiving the Negative

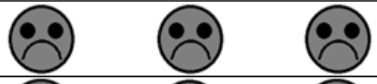
The mood-driven scope of attention has implications during social interactions; some are advantageous, and some detrimental. Socially, a narrow

ASE, when focusing on a negative (i.e. sad or dangerous) target, at any distance, is an advantageous, survival-based response (Coon, & Mitterer, 2008; Smith, Seger, & Mackie, 2007). Negative items need to be scrutinized for their level of threat in an on-going and preferential manner, and the brain tries to assure that distractions are not permitted (Kolb, & Whishaw, 2015; Stöttinger, & Perner, 2006). Healthy control, state and trail anxiety and depression participants responded in this adaptive manner to sad targets, with one exception: State anxiety, with sad targets having far, congruent distractors (Table 9).

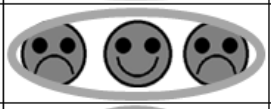
The data suggests that when state anxiolytics view a sad target, with far away emotional distractors, their ASE broadens when compared to control (Table 9). This is a reversal of the advantageous ASE narrowing seen in all other groups during sad items of focus. To investigate this conditional event, we evaluated the ASE of each condition, separately (Table 10).

Table 10. Perception of Stimuli (A) by Mood Group (B-E)

(A)

Target	Congruency	Emotional Stimuli Presented: Near	Emotional Stimuli Presented: Far
Happy	Congruent		
	Incongruent		
Sad	Congruent		
	Incongruent		

(B)

Target	Congruency	Healthy Control Perceived Stimuli: Near	Healthy Control Perceived Stimuli: Far
Happy	Congruent		
	Incongruent		
Sad	Congruent		
	Incongruent		

(C)

Target	Congruency	State Anxiety Perceived Stimuli: Near	State Anxiety Perceived Stimuli: Far
Happy	Congruent		
	Incongruent		
Sad	Congruent		
	Incongruent		

(D)

Target	Congruency	Trait Anxiety: Perceived Stimuli — Near	Trait Anxiety: Perceived Stimuli — Far
Happy	Congruent		
	Incongruent		
Sad	Congruent		
	Incongruent		

(E)

Target	Congruency	Depression: Perceived Stimuli — Near	Depression: Perceived Stimuli — Far
Happy	Congruent		
	Incongruent		
Sad	Congruent		
	Incongruent		

Gray oval = ASE comparable to that of control group, black = ASE difference

These data (Figure 10) reveal some interesting differences between the ASEs and therefore the perception of emotional stimuli of all groups. Firstly, these data reflects that the tenants of attentional control to sad stimuli are being utilized in a beneficial and survival-prone manner by trait and depression (Figure 19 and the non-significant results in Table 9). Examples of this could range from a bear in the woods to approaching a friend who responds with a frown; both

inform human survival needs (Brosch, Pourtois, Sander, & Vuilleumier, 2011; Graziano, 2014; Sander, & Vuilleumier, 2011). The same was true of the state group, but with one exception: sad target, far distractor, congruent condition (i.e., ☹ ☹ ☹; Table 9; state column). This bias for the highly negative, emotion-based stimuli cannot be categorized as a healthy, or as an advantageous attentional mechanism.

Secondly, compared to the RTs of all other groups, the state groups sad, far, congruent RTs, are extremely slow (*M* = 612), compared to control (*M* = 571), or trait (*M* = 576) or depression (*M* = 586) (Table 7). This indicates the state anxiety group is spending a large amount of neural effort observing the sad, far, congruent condition. The interesting portion of this occurrence is that the state participants are only experiencing this slowing when the distractors are far from the target. Therefore, as seen in trait and depressions inability to evaluate near emotional saliency of a happy targets distractors when they are in close prolixity to the target-emotion, we see states inability to 'disengage' or perhaps 'efficiently process' sad target when sad distractors are at a distance.

Even though the state group should have a narrow ASE, and only perceive the sad emotional stimuli, the state group perceives a difference in the sad targets congruent condition (Table 9). However, there was no significant difference between sad, far incongruent in state vs. control (Table 9; last 2 rows), and state had no congruency effect for the sad far condition (Figures 21 and 22). This implies that the state group did not perceive a difference in the sad

incongruent distractors over any other sad target congruencies, at any distance. This data examples, with the exception of the sad, far, congruent condition, that the state brain perceived all other sad target distance congruencies with a narrow ASE (i.e., the advantageous, survival-based awareness, limited to the perception of only the danger target ☹, and excluding distractors).

Lastly, the state groups sad, far, congruent, broad ASE also implies that the state group recognized the distractor-type (i.e., negative), at a particular distance (i.e., far), during a time when the brain should have activated the fear response, triggering a narrow ASE to inhibit distractors and increase survival during danger. For state, this broad ASE is a complete divergence from a healthy scope of attention during sad emotional stimuli (i.e., the ASE should be narrow). The consequences of this ASE reversal would evidence in a heightened perception of fear items in the environment. Said differently, where state should advantageously focus on the one threat item (i.e.,☹), this disadvantageously broad ASE would, instead, force processing of all items (i.e., ☹☹☹) during the most neurologically taxing distance, far (i.e., ☹ ☹ ☹).

Functionally, these data would have the real-world consequence of perceiving a higher amount of danger than other groups (i.e., a group of people frowning may seem like anger, or seeing joggers approach may be identified as ‘intent to harm’). Therefore, state anxiolytics may exhibit the same behavioral markers of social withdrawal or isolation as seen in depression, but for a different reason. If every slightly negative group viewed from afar was perceived as high

danger, no one would approach a social gathering. Furthermore, because the enhanced fear is occurring at a far distance, state anxiety sufferers would have motivation to flee, not approach and reassess.

Therefore, where intimate social conversations are hard for trait and depression to decipher, state individuals would not get to the intimate conversation stage as they would self-isolate for protection.

Perceiving the Positive

Socially, a broad ASE, when focusing on a positive (i.e. happy or safe) target, at any distance, is an advantageous, survival-based response (Coon, & Mitterer, 2008; Smith, Seger, & Mackie, 2007).

All groups showed a broad scope of attention to happy targets, when competing emotional information in distractor faces was distant from the target. The analogous real life situation might be if your friend, the item of focus, displays a happy facial expression, but those at other tables are clearly sad or angry, suggesting that the happy display you are engaged in may be 'inappropriate for the circumstances'. The mood disorders studied here appear to have a comparable level of sensitivity (to healthy individuals) when the target is happy (i.e., is safe) and the emotional salience is far away. Here, the scope of attention allows recognition that the surrounding environment has become negative, and the ability to immediately recognize that change is imperative to survival.

An interesting, and perhaps puzzling aspect of these results is that once groups were viewing a happy target in the near condition, these groups displayed some drastic changes. The control group and the state group, with broad ASEs, could discern similarities or differences between target and distractor emotional displays, but the Trait and Depression groups displayed narrow ASEs, and could not.

A broad scope of attention brings with it the ability to differentiate among the emotional states within a group of individuals (Barratt & Bundesen, 2012; Diéguez-Risco, Aguado, Albert, & Hinojosa, 2015; Kanske & Kotz, 2011). Humans spend their lives evaluating other humans' emotional output for possible signs of danger/no-danger so that the appropriate social interaction can commence (i.e., are they happy to see me, scared of me, might yell at me?). Without the ability to emotionally gauge our environment, quickly and accurately, from afar (i.e. an ability all the groups have) and then confirm our environmental state when near (i.e., an ability which trait and depression don't have), our chances for physical, social, and emotional survival are decreased. In fact, one could argue, that the evaluation of the emotional variance of those humans nearest to you is the most important aspect of survival. The ones nearest you could pose the most danger. Therefore, those without the ability to assess emotions in the happy, near condition, could be most vulnerable to physical, emotional, psychological harm in our society.

Functioning With a Mood Disorder

These data reflect that functioning with a mood disorder means functioning at a disadvantage when perceiving emotion. The state group is functioning perceptually like the control group (i.e., has comparably, broad ASEs, in the happy target near congruencies), just less efficiently responding. An example of how this might evidence in a state anxiolytic is that they might be slow to perceive when others are upset (i.e., whether the upset person is focus of their attention, or part of the group dynamic). We could assume that taking significantly longer to process emotional information on an ongoing basis could be social deemed as being mean, unfeeling toward others emotional states, or allow the individual to take too long to interpret a negative emotional situation to the point that their survival is in peril.

Those who have, trait anxiety and depression would have difficulties 'reading the room' so to speak in close interactions. They would be unable to gauge the emotionality of a small group (i.e., only divining the emotionality of the focus of their attention). This would make it harder to function in social, business, and family setting where the social system includes concurrent interactions with multiple emotional states (i.e., every situation). A simple example could be a trait anxiolytic or depressive individual watching a video and is unable to process the happy or annoyed motion exhibited in their spouse.

The trait anxiety and depressive groups show that they are not responding differently (i.e., significantly slower) than the control group, but, depressives

mirror traits ‘inability to gauge the emotionality of a group’ (i.e., they have the same narrow attentional scope in the happy near condition).Both depression and trait have a decreased ability to limit negative distractors, which creates an inability to decipher emotion in a group setting, and may explain the depressed symptomology related to the withdrawal from social function; as exerting energy and still not be able to process the emotions of multiple people at once, would create a large neural load. However, it does not explain the mechanism in trait anxiolytics who do not exhibit social withdrawal.

These results suggest that state anxiolytics are relatively slower in responding to emotional information in a facial stimulus. Once they identify the face as sad at far range, they experience a broad ASE and a heightened fear response. Once they identify the face as happy at close range, they achieve the same, broad, scope of attention as healthy individuals. By contrast, once depressives and trait anxiolytics identify a positive emotional expression, they are restricted in their ability to recognize contrasting or changing expressions in individuals who are in close proximity to their focus of attention. Depressives and individuals with high trait anxiety have a relatively narrower SoA, restricting their perception of close-range emotional-interactions. The present findings indicate that individuals with mood disorders process emotional information differently than healthy individuals.

Conclusion

In conclusion, the findings of this study show that the attentional scope effect is a behavioral-marker of distinct mood disorders; even in a comorbid environment. Therefore, these data provide evidence that the scope of attention's modulation can be utilized to ascertain if each, individual, mood-disorder is present, even in the presence of other, highly correlated mood-disorders.

Furthermore, these data provide evidence that those suffering disorders of mood exhibit a disadvantageous modulation their scope of attention during emotional interactions. As the scope of attention sets the limits of visual emotional perception, the data suggests humans with mood-disorders perceive the emotional world differently than those without a mood-disorder.

Limitations

The first limitation was sample size. A larger sample size would allow a greater number of high scorers, allowing the inclusion of mood-groups with higher mean scores, and providing a larger differentiation between groups. The second limitation may have been comorbidities between mood-groups. Evaluating groups without mood comorbidities may allow a more realistic correlation of the effect of mood on attentional scope. However, the goal of this study was to identify if the attentional scope effected real-life emotional perception during mood. With high comorbidity a reality in the human populous, the concern may be mute, and perhaps studies containing mood-comorbidities should be the norm (i.e., analyzed as depression + trait level, depression + state

level, etc. The third limitation is the ‘unforeseen interaction’; an undefined mediator or moderator may be present (i.e., effecting mood vs. the scope of attention), making these results not solely attributable to the ASE.

Future Research

It has been suggested that attention deficits may precede the emergence of mood-disorders (Leppänen, 2006), suggesting that those at risk for developing a disorder of mood may present with the same biases in attention and attentional scope inherent to diagnosed individuals. Therefore, future research should focus on the neuroimaging of human patients using a target-distractor with distance task to compare attentional scope effects with brain size in those with or without diagnosed mood disorders. Brain size is a biological marker, or biomarker, of a current or possible mood-disorder, therefore, attentional scope abnormalities may correlate as a behavioral marker of mood-disorders.

Additionally, future research should focus on a substituting a behavioral-marker for the current first-line pharmacological interventions though computational behavioral tasks. Medical diagnostic process for most patients includes answering limited questions or expressing an interpretation of their own symptomology. Due to co-morbid symptomology throughout mood-disorders (Spielberger, et, al., 1983; Vitasari, et al., 2011; Yang, et al., 2016), the physician then prescribes the ‘best’ pharmacology for the expressed symptomology (i.e., I feel sleepy, I feel anxious, I don’t like to do things anymore). This leads to high misdiagnosis and low symptomology resolution on the 1st medication prescribed.

Therefore, future research should investigate the creation of a shortened computational intervention during the patient's waiting room time to help target the pharmacology or other intervention prescribed. This would also allow real-time tracking of the patients ASE with an effective, statistical correlation of mood-behavioral-data. This illuminates the possibility of medical intervention before a transient mood-variance becomes a pathological mood-disorder (i.e., something not available at this time).

A longitudinal study in a medically-based facility, where healthy controls, pre-diagnosed, possible misdiagnosed, and post diagnosed individuals could repeat the task over a period of years could investigate the ASE over time in healthy vs. mood-disordered groups. The attentional scope differences could be tracked and correlated to the expression, progression, or resolutions of disease symptomology. The benefit would be to advance our understanding of the normal scope of attention, and/or normal perception-differences over the lifetime

Lastly, future research should allocate focus to those within the Autism Spectrum population. Autisms social-emotional and functional aspects are complex. One of the most severe barriers to quality of life and social interaction is the autistic propensity to withdraw from human interaction, while leaning toward non-human interaction (i.e., choosing to interact with a cell phone or computer over a person). This creates a divide which prohibits that patient, their family, and medical professionals from understanding what the autistic spectrum patient perceives or how their perception of an event may differ from the non-autistic

population. Therefore, the future application of this paradigm to those within the autism spectrum may allow non-autistics to glimpse perceptual differences leading to more targeted or more effective therapies for those with autism.

APPENDIX A:

INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL

CALIFORNIA STATE UNIVERSITY
SAN BERNARDINO

College of Social and Behavioral Sciences
Department of Psychology

Informed Consent

You are invited to participate in a study being conducted by Professor Hideya Koshino of the Psychology Department of California State University, San Bernardino (CSUSB). This study is approved by the Psychology Department subcommittee of the Institutional Review Board of California State University, San Bernardino, and a copy of the official Psychology IRB stamp of approval should appear on this consent form. The University requires that you give your consent before participating in this study.

In this study you will be asked to complete computer-based tasks. The experiment will take aproximately one hour. At the beginning of each trial, a central fixation point will appear. Then a stimulus display is presented and you are asked to make a response according to instructions. After the computer task, you will be asked to complete some questionnaires. All of your responses will be held in the strictest of confidence by the researchers. You will also be asked to complete a demographic questionnaire. This information will be stored separately from your responses to protect the anonymity of your responses. The data will be locked and stored in SB-452G. No identifying information will be attached to your data from this study, so your participation will be anonymous. The SONA system does record identity information so that you can be awarded extra credit in one of your psychology classes, but this will not be attached to your data and cannot be connected to your responses in any way, so maintaining your anonymity. The data might be deposited to a repository. All data will be reported in group form only. You may receive the group results of this study after Spring 2017 by contacting Dr. Hideya Koshino at hkoshino@csusb.edu.

The experiments involve no risks beyond those of daily life, and no direct benefits to the individual other than an introduction to psychological research and extra credit in one of your courses. However, your data may help to increase our understanding of attention and emotion.

Your participation in this study is completely voluntary and you are free to withdraw at any time without negative consequences. You may receive 5 units of extra credit at your instructor's direction for your participation. Please feel free to ask any questions that you have. Should questions concerning the study arise at a later date, please do not hesitate to contact the principal investigator at the phone number or address below, or in the event of a research-related concern or injury, please contact the Psychology Department subcommittee of the Institutional Review Board of California State University, San Bernardino. Results of this study will be available from Dr. Koshino after the Spring quarter of 2017 upon request.

Please read the following before indicating that you are willing to participate.

1. The study has been explained to me and I understand the explanation that has been given and what my participation will involve.

2. I understand that my participation is entirely voluntary, and that I may withdraw from participation at any time, or refuse to answer any specific question, without penalty or withdrawal of benefit to which I am otherwise entitled.

3. I understand that if I have any questions or concerns regarding this study, or if I wish to receive additional explanations after my participation is completed, I can contact Dr. Koshino at (909) 537-5435 or hkoshino@csusb.edu.

I acknowledge that I have been informed of, and understand the true nature and purpose of this study, and I freely consent to participate. I acknowledge that I am at least 18 years of age.

Please indicate your desire to participate by placing and "X" on the line below.

Participant's X _____

Date: _____

CALIFORNIA STATE UNIVERSITY PSYCHOLOGY INSTITUTIONAL REVIEW BOARD SUB-COMMITTEE			
APPROVED	12/6/16	VOID AFTER	12/6/17
IRB #	H-165P-09	CHAIR	

APPENDIX B:

STATE-TRAIT ANXIETY INVENTORY - TRAIT (STAI-T)

STAI-T

Participant instructions: Below is a list of statements which can be used to describe how people feel. Beside each statement are four numbers which indicate the degree with which each statement is self-descriptive of your mood in general (e.g., 1 = not at all, 2 = a little, 3 = moderately, 4 = very much so). Please read each statement carefully and circle the number which best indicates how you feel in general, or over the last 1 to 2 weeks.

1----------2----------3----------4
Not at all A Little Moderately Very Much So

Questions:

1. My heart beats fast.
2. My muscles are tense.
3. I feel agonized over my problems.
4. I think that others won't approve of me.
5. I feel like I'm missing out on things because I can't make up my mind soon enough.
6. I feel dizzy.
7. My muscles feel weak.
8. I feel trembly and shaky.
9. I picture some future misfortune.
10. I can't get some thought out of my mind.
11. I have trouble remembering things.
12. My face feels hot.
13. I think that the worst will happen.
14. My arms and legs feel stiff.
15. My throat feels dry.
16. I keep busy to avoid uncomfortable thoughts.
17. I cannot concentrate without irrelevant thoughts intruding.
18. My breathing is fast and shallow.
19. I worry that I cannot control my thoughts as well as I would like to.
20. I have butterflies in the stomach.
21. My palms feel clammy.

(Spielberger, 1972; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983)

APPENDIX C:

STATE-TRAIT ANXIETY INVENTORY - STATE (STAI-S)

STAI-S

Participant instructions: Below is a list of statements which can be used to describe how people feel. Beside each statement are four numbers which indicate the degree with which each statement is self-descriptive of mood at this moment (e.g., 1 = not at all, 2 = a little, 3 = moderately, 4 = very much so). Please read each statement carefully and circle the number which best indicates how you feel right now, at this very moment, even if this is not how you usually feel.

1----------2----------3----------4
Not at all A Little Moderately Very Much So

Questions:

1. My heart beats fast.
2. My muscles are tense.
3. I feel agonized over my problems.
4. I think that others won't approve of me.
5. I feel like I'm missing out on things because I can't make up my mind soon enough.
6. I feel dizzy.
7. My muscles feel weak.
8. I feel trembly and shaky.
9. I picture some future misfortune.
10. I can't get some thought out of my mind.
11. I have trouble remembering things.
12. My face feels hot.
13. I think that the worst will happen.
14. My arms and legs feel stiff.
15. My throat feels dry.
16. I keep busy to avoid uncomfortable thoughts.
17. I cannot concentrate without irrelevant thoughts intruding.
18. My breathing is fast and shallow.
19. I worry that I cannot control my thoughts as well as I would like to.
20. I have butterflies in the stomach.
21. My palms feel clammy.

(Spielberger, 1972; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983)

APPENDIX D:

CENTER FOR EPIDEMIOLOGICAL STUDIES DEPRESSION SCALE (CESD)

CESD

Participant instructions: You will be shown a list of some ways you may have felt or behaved. Please indicate how often you have felt this way during the last week by selecting the appropriate response.

1	2	3	4
Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)

Questions:

1. I was bothered by things that usually don't bother me
2. I did not feel like eating; my appetite was poor
3. I felt that I could not shake off the blues even with help from my family or friends
4. I felt I was just as good as other people
5. I had trouble keeping my mind on what I was doing
6. I felt depressed
7. I felt that everything I did was an effort
8. I felt hopeful about the future
9. I thought my life had been a failure
10. I felt fearful
11. My sleep was restless
12. I was happy
13. I talked less than usual
14. I felt lonely
15. People were unfriendly
16. I enjoyed life
17. I had crying spells
18. I felt sad
19. I felt that people disliked me
20. I could not get going

(Radloff, 1977)

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