ISSN 1577-7057

Volume 23, number 2 March 1, 2023
Volumen 23, número 2 1 Marzo, 2023

ISSN: 1577-7057

IJP&PT

International Journal of Psychology & Psychological Therapy

https://www.ijpsy.com

IJP&PT is included in the following indexing and documentation Centers

International Journal of Psychology & Psychological Therapy, 2023, *23*, 2, 117-147

The Effect of Attention Disengagement on Anxiety and Emotion Maintenance: A Theoretical Perspective

Alex Grattery

University of Pittsburgh, USA

Abstract

Cognitive processes such as attention and working memory are necessary for cognitive components of anxiety and other emotions. Moreover, the content of working memory and attention may maintain anxiety states. By extension, disengaging from mood-congruent material in attention and working memory may stop the maintenance of emotions such as anxiety. However, common existing therapeutic techniques do not fully disengage attention and other cognitive engagements from mood-congruent thoughts, mental images, and urges. This paper theorizes that fully disengaging attention, but not awareness, of mood-congruent thoughts and images eliminates or nearly eliminates feelings of anxiety. This paper connects cognitive, neuroscientific, and clinical evidence on the role of attention and working memory in anxiety and other emotions with the Cognitive Disengagement Technique, a relatively novel clinical technique which is a core component of Rumination-Focused ERP. By doing so, the hypotheses presented in this paper are highly testable. Possible mechanisms of extinction learning and emotion regulation beyond anxiety alone are discussed, both of which have important implications for clinical practice.

Key words: attention disengagement, mechanisms of anxiety, exposure therapy, internal attention, emotion regulation.

How to cite this paper: Grattery A (2023). The Effect of Attention Disengagement on Anxiety and Emotion Maintenance: A Theoretical Perspective. *International Journal of Psychology & Psychological Therapy, 23, 2,* 117-147.

Novelty and Significance

What is already known about the topic?

- Working memory resources are heavily involved in the maintenance of anxiety and other emotions.
- Attentional processes form the core components which select and maintain information in working memory.
- Attention resources available for anxiety-related thoughts moderate level of anxiety.

What this paper adds?

- This paper proposes an argument that internal attention towards anxiety-related cognitions is necessary for the emotional experience of anxiety.
- This paper argues that disengagement from anxiety-related cognitions stops the emotional experience of anxiety.
- This paper examines a recently developed cognitive technique that may more effectively disengage attention than other, more popular techniques.

Mood disorders and anxiety disorders are among the most common mental disorders and are linked with high levels of distress (Bandelow & Michaelis, 2015). The primary symptom of anxiety disorders, conscious feelings of anxiety, is a central diagnostic marker of anxiety disorders. Indeed, a lower ability to regulate emotions is strongly linked with greater anxiety and depression (K. S. Young, Sandman, & Craske, 2019). Moreover, teaching people to better regulate their emotions through techniques such as mindfulness, distraction, and reappraisal is linked with reductions in feelings of anxiety and better clinical outcomes (Dawson *et alia*, 2020; Hofmann, Sawyer, Witt, & Oh, 2010; McRae, 2016; Naragon-Gainey, McMahon, & Chacko, 2017). Emotional dysregulation is linked with cognitive behaviors such as worry and rumination (K. S. Young, Sandman, & Craske, 2019), both of which maintain anxiety states (Newman, Llera,

* Correspondence: Alex Grattery, University of Pittsburgh, 5862 Forbes Ave, 15217 Pittsburgh PA, USA. Email: gratterya@upmc.edu

Erickson, Przeworski, & Castonguay, 2013; Olatunji, Naragon-Gainey, & Wolitzky-Taylor, 2013). Therefore, understanding the role that cognitive processes play in rumination and worry and ultimately in maintaining state and trait anxiety is important. Such research may lead to more effective emotion regulation techniques and better clinical outcomes for anxiety disorders and other mood disorders.

Role of Working Memory in Anxiety Maintenance

Cognition plays an important role in anxious experience. For example, worry and rumination induction increases state anxiety and depression (McLaughlin, Borkovec, & Sibrava, 2007). Furthermore, anxious apprehension, a propensity to engage in negative repetitive thinking such as worry or rumination, is a core part of anxiety along with anxious arousal, the states of hypervigilance and fear (Heller, Nitschke, Etienne, & Miller, 1997; Sharp, Miller, & Heller, 2015). Verbal working memory and behaviors associated with anxious apprehension, such as worry, engage the dorsal, medial, and ventral prefrontal cortex (PFC) (D'Esposito *et alia*, 1998; Heller *et alia*, 2008; Kalisch, Wiech, Critchley, & Dolan, 2006; Owen, McMillan, Laird, & Bullmore, 2005; Paulesu *et alia*, 2010; Vytal, Cornwell, Letkiewicz, Arkin, & Grillon, 2013; Sato, Dresler, Haeussinger, Fallgatter, & Ehlis, 2014; Aoki *et alia*, 2011), leading some authors to hypothesize that the PFC is an area of the brain involved in the interaction of cognition and emotion (Pessoa, 2008). Notably, the medial PFC is an emotion regulation region implicated in anxiety disorders (Duval, Javanbakht, & Liberzon, 2015). It also provides top-down regulation of fear and anxiety responses and is activated during Conditional Stimulus (CS) presentations (Lee, Kim, Kwon, Lee, & Kim, 2013). Activation of other areas of the PFC, namely the dorsolateral PFC, is linked with working memory activation and is negatively correlated with state and trait anxiety (Balderston *et alia*, 2020, 2017; Kim & Jung, 2006), indicating that the dlPFC downregulates anxiety, possibly through a relationship between attention control and emotion regulation (Ochsner, Silvers, & Buhle, 2012; Robinson, Pike, Cornwell, & Grillon, 2019). Lastly, forms of anxious apprehension such as worry and rumination increase anxiety and consume working memory resources (Ashcraft & Kirk, 2001). Therefore, cognitive processes, and specifically working memory, play an important role in regulating and maintaining emotions such as anxiety, likely through moderating anxious apprehension, the cognitive component of anxious experience.

A defining feature of working memory is that only a limited amount of information can be held in working memory at a given time, a phenomenon termed working memory capacity (Baddeley, 1992). Given these capacity limits, the contents of working memory must be updated efficiently, a task completed by executive processes (Friedman & Miyake, 2004; Hasher, Zacks, & May, 1999; Joormann & Quinn, 2014). These executive processes inhibit irrelevant material, discard no-longer relevant material, and bring relevant information into working memory. However, while working memory is efficient at retrieving relevant information from long-term memory and removing non-relevant information, it is not perfect (Oberauer, 2019). Cognitively demanding cognitions such as worry, a subset of anxious apprehension, take up space in working memory and therefore have been argued to reduce the capacity for other cognitive processes (Derakshan & Eysenck, 2009). This is consistent with attentional control theories of anxiety which propose that worry is a cognitively demanding dual-task that interferes with the inhibition of irrelevant stimuli and responses (Eysenck, Derakshan,

Santos, & Calvo, 2007; Moran, 2016). This is well-supported: anxiety induction decreases working memory capacity (Moran, 2016). Worry (Sari, Koster, & Derakshan, 2017), state anxiety (Vytal *et alia*, 2013), and trait anxiety (Qi *et alia*, 2014) are all negatively correlated with working memory capacity. Moreover, people with high trait worry have been found to have a more restricted working memory capacity during worry induction in comparison to positive thoughts than people with low trait worry (Hayes, Hirsch, & Mathews, 2008), suggesting that trait anxiety may strengthen the effects of anxiety induction on lowering working memory capacity. These findings suggest that working memory resources are used during experiences of anxiety, lowering working memory capacity for cognitively demanding tasks.

Individual differences in working memory capacity relate to differing abilities in selecting and updating information in working memory (Wilhelm, Hildebrandt, & Oberauer, 2013). Since state anxiety induction decreases working memory capacity, it likely interferes with the selection and updating of information in working memory (Moran, 2016; Vytal *et alia*, 2013). Similarly, individuals with greater working memory capacity are more able to reduce negative and positive emotional intensity than people with lower working memory capacity (Schmeichel, Volokhov, & Demaree, 2008). Indeed, there is a strong connection between working memory capacity and emotion regulation (Barkus, 2020; Etkin, Büchel, & Gross, 2015; Gyurak, Goodkind, Kramer, Miller, & Levenson, 2012). One group of attentional process, orienting, which is responsible for the selection and filtering of information (Fan & Posner, 2004), has been found to be improved after working memory training (Xiu, Wu, Chang, & Zhou, 2018). In that study, a significant correlation was found between the orienting function of attention and Late Positive Potential in relation to emotion regulation. These findings suggest that there is a link between working memory capacity and emotion regulation, and this connection may be mediated by the ability to control attentional processes such as orienting. In anxiety, then, working memory capacity may be reduced in part because of lower ability to control the contents of working memory through attention.

Attention Control and Anxiety

Evidence from clinical contexts supports this connection. For example, improved emotional regulation skills during Emotional Regulation Therapy are associated with increased attention regulation skills (Renna *et alia*, 2018). Moreover, certain models propose that cognitive control, and similarly attentional control, defined as the ability to allocate attention and inhibit task-irrelevant information (Knudsen, 2007), are comprised of three processes: inhibition, updating, and shifting (Friedman & Miyake, 2017). In this account of attentional control, inhibition prevents attentional resources from being distributed to task-irrelevant stimuli (Miyake *et alia*, 2000). Switching involves controlling attentional resources to remain focused on task-relevant stimuli by shifting back and forth between tasks. Lastly, updating involves monitoring the information contained in working memory. Deficits in inhibition and switching in particular are responsible for lowered task efficiency in people with anxiety (Berggren & Derakshan, 2013), and both state and trait anxiety are associated with deficits in these processes (Shi, Sharpe, & Abbott, 2019). Thus, emotion dysregulation is linked with deficits in attentional processes which control the focus of attention and the contents of working memory.

Additionally, attentional control is a component of cognitive control (also known as executive function), which refers to cognitive processes that allow for flexible

behavior to adapt for current goals (Inzlicht, Bartholow, & Hirsh, 2015; Zelazo & Cunningham, 2007). Both cognitive control (Touroutoglou, Lindquist, Dickerson, & Barrett, 2015) and emotion regulation (Aldao, Sheppes, & Gross, 2015; Bonanno & Burton, 2013) regulate internal mental phenomena to allow for flexible behavior. They also relate neurologically, as both cognitive control (Jurado & Rosselli, 2007; Niendam *et alia*, 2012) and emotion regulation (Braunstein, Gross, & Ochsner, 2017; Ochsner, Silvers, & Buhle, 2012) are strongly associated with activation in the frontoparietal network (Ochsner, Silvers, & Buhle, 2012). Affective cognitive control relies on the same neural circuitry as areas involved in performance of working memory tasks such as the dorsolateral PFC (Schweizer, Grahn, Hampshire, Mobbs, & Dalgleish, 2013). This affective control network is involved in downregulating emotional distress and is hypoactivated in certain neuropsychiatric disorders such as depression. Therefore, cognitive control and emotion regulation are similar in several aspects.

Because cognitive control and emotion regulation are so intertwined in both their processes and mechanisms, and attentional control plays a large role in regulating emotions, attention towards mood congruent thoughts and images likely plays an important role in maintaining emotions. Expanding on this connection, Moran (2016) draws a connection between attentional accounts of working memory capacity and attentional control accounts of anxiety by noting that these accounts are highly consistent. Individual differences between individuals with and without anxiety in WMC task performance such as in complex span tasks are driven by the ability to regulate the information within working memory by selecting relevant information and inhibiting and removing irrelevant information (Engle, 2002; Moran, 2016). For example, individuals with more worry and rumination are less able to control the contents of working memory (Beckwé, Deroost, Koster, De Lissnyder, & De Raedt, 2014). Attentional control accounts of working memory propose that worry is a dual-task that uses attentional resources, and therefore interferes with the ability to regulate the information being attended to (Eysenck et alia, 2007). In both cases, cognitive components of anxiety such as anxious apprehension interfere with the ability to regulate which information is selected and inhibited (Eysenck & Derakshan, 2011), indicating that attentional control is a core component of working memory regulation. Moreover, under the Selection, Optimization, and Compensation with Emotion Regulation framework (SOC-ER), working memory capacity is defined as the ability to selectively direct attention (Opitz, Gross, & Urry, 2012; Xiu *et alia*, 2018). Consistent with these accounts, there is preliminary evidence that working memory training can improve attentional control in certain contexts and can reduce trait anxiety (Sari, Koster, Pourtois, & Derakshan, 2016; Xiu *et alia*, 2018). Controlling the content of working memory through attentional processes is very likely then a core mechanism of emotion regulation.

Other neuroscientific evidence provides further support that working memory plays a role in the regulation of anxiety through re-allocating attention. Higher levels of cognitive load, defined as the amount of working memory and attention resources being used, leads to decreased negative emotional experiences from negative stimuli and reduced neural activation in areas of the brain related to emotional processing (Van Dillen, Heslenfeld, & Koole, 2009; Van Dillen & Koole, 2007), such as the amygdala and orbitofrontal cortex. At the same time, higher levels of cognitive load raise activation in the frontoparietal network (Kellermann *et alia*, 2012) more than tasks with lower levels of cognitive load. This is thought to reflect a shift of resources from affective processing mediated by the frontoparietal network. This suggests that

reduced cognitive processing has a causal relationship with lowered negative emotional experience. This is consistent with other research which has found that the purpose of areas of the brain associated with emotion regulation is to downregulate emotional distress through connections to the amygdala from areas including the prefrontal cortex through inhibition and re-allocation of attention (Andrewes & Jenkins, 2019; Etkin, Egner, & Kalisch, 2011; Kellermann *et alia*, 2012; Ochsner & Gross, 2005; Wager, Davidson, Hughes, Lindquist, & Ochsner, 2008). Notably, this re-allocation of attention to regulate emotion occurs even when the negative stimuli are task-relevant and cannot be ignored (Kellermann *et alia*, 2012), suggesting that visual and emotional processing are somewhat dissociable, and that internal attention, rather than visual attention, may be re-allocated to regulate emotion.

In disorders such as anxiety, attention is not always successfully re-allocated and as a result, emotions are not always properly regulated. Attentional control theories of anxiety argue that worry-related thoughts consume working memory resources (Derakshan & Eysenck, 2009; Eysenck *et alia*, 2007; Rapee, 1993). A core component of many disorders, including anxiety, is negative repetitive thinking (American Psychiatric Association, 2022; Sharp, Miller, & Heller, 2015). Therefore, anxiety likely relates to attentional deficits because of increased attention towards task-irrelevant anxiety-related thoughts. Deficits in inhibition, therefore, lead to failures to prevent attention engagement of worry-related thoughts. Deficits in switching lead to failures to bring attention back to task-relevant information, which means people with this deficit struggle to disengage from worry-related thoughts. In support of these connections, both state and trait anxiety are negatively correlated with attentional control (Shi, Sharpe, & Abbott, 2019), and worry consumes more attentional control resources in people with GAD than healthy participants (Stefanopoulou, Hirsch, Hayes, Adlam, & Coker, 2014). Attentional deficits maintain anxiety by making it difficult to inhibit and disengage from anxiety-related thoughts, mental images, etc. In turn, anxiety-related mental representations maintain feelings of anxiety.

Additionally, negative thought patterns such as rumination positively mediate the relationship between delayed attention disengagement and depressed mood (Yaroslavsky, Allard, & Sanchez-Lopez, 2019). These findings support models which hold that impaired attention disengagement from negative information maintains dysphoric emotions (Joormann, 2004; Koster, De Lissnyder, Derakshan, & De Raedt, 2011). Therefore, there is strong evidence that cognitive processes associated with anxiety and depression, such as worry and rumination, consume cognitive resources and maintain negative emotions by affecting the ability to select and regulate the information that is processed in attention.

Inhibition and Working Memory

Notably, the relationship between anxiety and working memory is not one-directional. At lower levels of cognitive load, anxiety impairs task performance. However, in tasks with a higher level of cognitive load, anxiety is reduced (Van Dillen, Heslenfeld, & Koole, 2009; Van Dillen & Koole, 2007; Vytal, Cornwell, Arkin, & Grillon, 2012). Cognitive load also reduces activation in brain regions associated with emotional processing (Van Dillen, Heslenfeld, & Koole, 2009; Van Dillen & Koole, 2007). This supports attentional accounts of anxiety because it provides evidence that anxiety involves cognitive processes that compete for processing with other tasks. It also provides evidence that these cognitive processes are important for the production

and maintenance of anxiety, and that inhibiting or 'crowding out' these processes can decrease anxiety (Joormann, 2010; Mikels & Reuter-Lorenz, 2019). Affective processing may be inhibited to bring more resources to the cognitive task, lowering emotional experience (Clarke & Johnstone, 2013). This is consistent with load theory, which argues that higher cognitive load reduces resources for other forms of processing including emotional processing (Lavie, Hirst, de Fockert, & Viding, 2004). Moreover, the capacity to update the contents of working memory is the best predictor of emotion regulation ability in a review studying several executive functions (Schmeichel & Tang, 2015), underscoring previous findings that emotion regulation requires inhibiting and selecting information in working memory. Taken together, working memory processes related to attentional control such as the selection and inhibition of information in working memory are crucial for the maintenance and regulation of anxiety.

The connection between working memory regulation and attentional control converges with the striking similarities between working memory and attention, specifically between working memory and direct, focused attention. The neural systems of working memory such as the prefrontal-parietal system, which allows us to regulate the information held in mind by selecting and refreshing certain information while inhibiting irrelevant thoughts, overlaps significantly with the prefrontal-parietal attentional system which allows us to selectively focus on certain information while tuning out irrelevant stimuli (Awh, Anllo-Vento, & Hillyard, 2000; Awh & Jonides, 2001; Diamond, 2013; Gazzaley & Nobre, 2012; Ikkai & Curtis, 2011; LaBar, Gitelman, Parrish, & Mesulam, 1999; Nobre & Stokes, 2011). Moreover, improvements in working memory can support improvements in selective attention (Stedron, Sahni, & Munakata, 2005), illustrating the connection between attention and working memory.

Role of Internal Attention in Anxiety

Attention to information in working memory such as thoughts, images, etc. relates to internal, as opposed to sensory, information. Indeed, certain authors have proposed a taxonomy for attention based on the targets of attention (Chun, Golomb, & Turk-Browne, 2011). In this framework, external attention involves attention towards directly observable external stimuli and can also be called perceptual attention. Internal attention involves attention towards thoughts, emotions, etc. and is responsible for the selection and modulation of internal information, such as the contents of working memory and long-term memory. It includes cognitive control and is sometimes called reflective attention. To support this distinction, there is evidence that perceptual load has different effects than working memory load (Lavie *et alia*, 2004) and that cognitive load, response selection, and task switching do not affect perceptual processing much (Pashler, 1994). Notably, since one main purpose of working memory is the manipulation of information in the absence of sensory information, working memory is comprised of internal attention processes (Chun, Golomb, & Turk-Browne, 2011).

In support of this connection between internal attention and working memory, neuroimaging research has found activation in the frontal and parietal areas during both refreshing and rehearsing as well as complex tasks requiring executive function (Duncan & Owen, 2000; E. Smith & Jonides, 1999). Moreover, greater activity in the dorsolateral prefrontal cortex during refreshing is associated with faster and more accurate long-term memory, suggesting that processes of reflective attention predict better long-term memory (Raye, Johnson, Mitchell, Reeder, & Greene, 2002). Indeed, many components

of working memory have been argued to be attention processes (Kuhl & Chun, 2014). Reviews of neuroscientific evidence show striking similarities between working memory and attention: attention allocation to internal representations is responsible for information encoded into working memory (D'Esposito & Postle, 2015), attention is allocated to objects in working memory to select and prioritize goal-relevant behavior over goal-irrelevant behavior (Nobre & Stokes, 2020; van Ede & Nobre, 2021), and shifting external attention and shifting attention towards information in working memory use the same underlying neural mechanism (Zhou, Curtis, Sreenivasan, & Fougnie, 2022). These findings suggest that attention towards internal representations, also called internal attention, is inseparable and perhaps analogous to components of working memory that are responsible for selecting, inhibiting, and maintaining information in working memory.

In particular, refreshing and rehearsal are two internal attention processes that maintain information in attention (Cowan, 2001; Pessoa, 2018), and are crucial for selecting, maintaining, and manipulating the contents of working memory (Chun & Johnson, 2011). Refreshing is the act of paying attention to a mental representation that was activated a few moments earlier. Rehearsal maintains information in working memory over somewhat longer intervals. In addition, reactivation and retrieving are attention processes indicated in long-term memory retrieval to working memory (Chun & Johnson, 2011). When information is brought into working memory, such as by reactivation and retrieving, it can then be maintained by rehearsal and refreshing, which improve memory retrieval (Johnson, Reeder, Raye, & Mitchell, 2002; Roediger & Karpicke, 2006; Souza, Rerko, & Oberauer, 2015). Thus, reflective attention is necessary for the selection, maintenance, and manipulation of information from working memory and long-term memory.

Since internal attention is used to select information to enter working memory, it determines which thoughts and mental representations enter awareness (Amir & Bernstein, 2021). Therefore, internal attention is crucial for the selection and production of thoughts, memories, and images (Posner, 1994), including maladaptive thought patterns such as spirals of negative repetitive thinking. These spirals may occur due to the inherent limited capacity of attention (Amir & Bernstein, 2021; Chun, Golomb, & Turk-Browne, 2011; Desimone & Duncan, 1995), requiring attention to bias certain information for further processing at the expense of other information. Biases in internal attention, in particular, select in favor of certain mental representations over competing internal and external stimuli (N. Myers, Stokes, & Nobre, 2017). In the case of anxiety, for example, anxiety-related mental representations such as thoughts or images are repeatedly selected into working memory, leading to a selection history of those representations (Theeuwes, 2019). This internal selection history may bias future selection towards those mental representations (Ehring & Watkins, 2008), maintaining anxiety-related cognition such as worry and rumination (Everaert, Bernstein, Joormann, & Koster, 2020) at the expense of external or other internal stimuli. This inability to filter internal distractors results in an inability to sustain task-relevant internal and external information (Amir & Bernstein, 2021), which can in part explain why anxiety interferes with task efficiency.

Therefore, attention and working memory are highly intertwined, such that many components of working memory are themselves attention processes. These internal attentional and working memory processes are used to maintain the contents of working memory, also called mental representations, or thoughts, images, etc. by selecting and maintaining them through attentional processes. Thoughts, mental images, etc. comprise central components of negative emotional experiences, such as anxious apprehension

and rumination. As mentioned earlier, maintaining or inhibiting information in working memory through control of attentional processes plays a crucial role in the maintenance, production, and regulation of emotions such as anxiety. Taken together, internal attention processes which select and maintain anxiety-related mental representations in attention and working memory may be necessary for the production and maintenance of conscious feelings of emotions such as anxiety. Indeed, there is strong evidence that both the content of working memory and the content of internal attention play a highly important role in the maintenance of negative emotional experiences, as will be discussed presently.

Certain cognitive accounts of psychopathology argue that mood-congruent information in working memory such as thoughts, memory recall, beliefs, etc. all maintain emotional states (Joormann, 2010). Certainly, negative mood is associated with congruent mental representations, such as thoughts, mental images, etc. in working memory (Siemer, 2005). Moreover, depressed individuals have difficulties removing irrelevant negative material from working memory, and these deficits are related to attention deficits (Joormann & Gotlib, 2008). Depressed individuals also report deficits in inhibiting negative material from entering working memory, and this failure to inhibit is thought to be a maintenance factor of depression (Cottencin et alia, 2008; Hertel & Gerstle, 2003; Joormann, LeMoult, Hertel, & Gotlib, 2009; Power, Dalgleish, Claudio, Tata, & Kentish, 2000). In support of this connection is research correlating working memory inhibition ability with the ability to repair negative mood, where greater inhibition allows for negative mood to be repaired more easily (Joormann, Siemer, & Gotlib, 2007). Among people with depression, inhibition biases cause mood-incongruent thoughts to become less accessible, keeping mood-congruent material in working memory and therefore maintaining negative mood (Joormann, 2010; Joormann & Quinn, 2014). A failure to inhibit mood-congruent material therefore plays a role in maintaining emotional experiences.

A defining difference between those with and without persistent negative mood is that the former display difficulty disengaging attention towards mood-congruent thoughts, images, etc. and those thoughts, images, etc. are harder to remove from working memory (Joormann, 2010). Clearly, then, the ability to control the contents of working memory and internal attention play an important role in recovering more quickly from negative affect. This is consistent with studies on emotional inertia, which find variables that are strong predictors of emotion episode length: the more persistent an emotional episode, the more important the preceding event is rated and the more rumination is present (Verduyn & Lavrijsen, 2015). Moreover, even imagining the situation that caused an emotional event, i.e., holding it in working memory, is linked with longer durations of those events (Verduyn, Delvaux, Van Coillie, Tuerlinckx, & Van Mechelen, 2009), providing further evidence that the content of working memory maintains emotional experiences.

Additionally, as cited earlier, there is evidence that working memory resources are necessary for the maintenance of anxiety. High levels of working memory usage by emotion-incongruent tasks (high cognitive load) decrease anxiety (Vytal *et alia*, 2012) by crowding out cognitive processing necessary for the experience of anxiety (Mikels & Reuter-Lorenz, 2019). Cognitive load decreases activation in emotional processing areas of the brain (Andrewes & Jenkins, 2019; Etkin, Egner, & Kalisch, 2011; Kellermann *et alia*, 2012; Ochsner & Gross, 2005; Van Dillen, Heslenfeld, & Koole, 2009; Van Dillen & Koole, 2007; Wager *et alia*, 2008) in part by re-allocating attention from emotion-congruent material.

Research on self-focused attention provides evidence that the content of attention maintains negative emotional experiences. Self-focused attention (SFA) is a type of internal attention that has been studied thoroughly in the context of Social Anxiety Disorder (Norton & Abbott, 2016). SFA involves heightened attention to detailed, self-focused observation, increasing awareness of self-relevant thoughts, mental images, and sensations (Clark & Wells, 1995), consistent with models of internal attention which argue that internal attention increases awareness of thoughts, images, and sensations (Amir & Bernstein, 2021). Several cognitive models argue that these mental representations of the self in social situations, self-focused attention, rumination, and thoughts of comparison all maintain anxiety (Clark & Wells, 1995; Hofmann, 2007; Rapee & Heimberg, 1997). Indeed, self-focused cognition is thought to maintain anxiety not just during social situations, but before and after as well (Clark & Wells, 1995).

In support of these cognitive models, there is a large amount of research connecting SFA and social anxiety. SFA is higher during social situations in both non-clinically and clinically socially anxious people than in healthy controls (Bögels & Mansell, 2004; Hope & Heimberg, 1988; Norton & Abbott, 2016; Rapee & Heimberg, 1997; Spurr & Stopa, 2002). Socially anxious people react more quickly than healthy controls to internal rather than external stimuli and have mostly negative self-cognitions (Heimberg, Bruch, Hope, & Dombeck, 1990; Mansell, Clark, & Ehlers, 2003), suggesting that these self-cognitions maintain social anxiety. SFA induction is causally linked with increases in state anxiety and avoidance through a variety of experimental methods (Bögels, Rijsemus, & De Jong, 2002; Grisham, King, Makkar, & Felmingham, 2015; Kashdan & Roberts, 2004; Woody & Rodriguez, 2000; Zou, Hudson, & Rapee, 2007). SFA is also linked with increased self-imagery, a causal mechanism of anxiety (Hackmann, Clark, & McManus, 2000; Hirsch, Clark, Mathews, & Williams, 2003).

Neural substrate research also reveals a connection between SFA and social anxiety (Schultz & Heimberg, 2008). SFA among socially anxious people is correlated with increased activation of neural structures related to introspection and awareness of bodily sensations, such as the medial PFC (Boehme, Miltner, & Straube, 2015). More broadly, models of emotion generation developed from neuroscientific evidence place attention allocation to stimuli in external or internal attention as a necessary step for producing emotions (Barrett, Mesquita, Ochsner, & Gross, 2007; Ochsner, Silvers, & Buhle, 2012). In these models, the focus of attention, which in the case of SFA would be internal stimuli, is selected for further processing which eventually gives rise to emotions such as anxiety.

Notably, SFA is highly related to working memory. Excessive self-focused cognition is linked with impairments in working memory capacity, suggesting that SFA uses working memory resources (Fergus, Weinzimmer, Schneider, & Storch, 2021). People with high trait social anxiety have difficulty disengaging attention from information that match the contents of working memory, indicating deficits in prefrontal top-down control and attention disengagement (Moriya & Sugiura, 2012). Moreover, some internal attention is bottom-up such as unwanted thoughts and memories in working memory which capture attention (Amir, Ruimi, & Bernstein, 2021; Cabeza, Ciaramelli, Olson, & Moscovitch, 2008; van Schie & Anderson, 2017). Since people with social anxiety have difficulty disengaging from these thoughts and memories, they stay in attention and working memory, maintaining anxiety.

Social anxiety, like other forms of anxiety, does not just involve anxiety during stressful situations. Anticipatory rumination and post-event rumination are types of

rumination done before and after a distressing social event, respectively (Norton & Abbott, 2016). They are very common among people with social anxiety, play a causal role in anxiety states, and are thought to maintain social anxiety (Norton & Abbott, 2016). Anticipatory rumination induction has been found to lead to increases in SFA (Mills, Grant, Judah, & White, 2014). Similarly, SFA induction increases post-event rumination, characterized by negative thoughts related to previous social performance after a social task (Gaydukevych & Kocovski, 2012). These findings provide support that self-focused attention has a causal relationship with ruminative patterns implicated in the maintenance of anxiety states.

In the long term, self-focused attention increases processing of self-relevant negative material by increasing cognitions, mental imagery, and memory recall associated with threat (Brozovich & Heimberg, 2008), thereby maintaining anxiety through negative interpretations and memory biases (Norton & Abbott, 2016). These memory biases are partially composed of inaccurate recall due to the individual focusing on biased information during the social task, such as negative cognitions involving negative interpretations. This is similar to research mentioned above on selection history, whereby internal attention selection biases future attention, making it difficult to stop negative thought patterns (Amir & Bernstein, 2021; Ehring & Watkins, 2008; Everaert et alia, 2020). Indeed, emotional reactivity to negative thoughts predicts difficulty disengaging internal attention from those thoughts and biases future selection of those thoughts (Amir, Ruimi, & Bernstein, 2021). This difficulty disengaging and increased attentional capture predicts negative repetitive thinking such as rumination, which in turn predicts anxiety and depression (Amir, Ruimi, & Bernstein, 2021; Koster *et alia*, 2011).

Therefore, internal attention maintains emotions such as anxiety in several ways. In the short term, internal attention selects and maintains anxiety-related mental representations such as thoughts or images in working memory through rehearsal and refreshing, even in the absence of an anxiety-related perceptual stimulus. The purpose of working memory and internal attention are to hold and select information for processing. In this case, these thoughts, images, etc. when held in working memory and paid attention to, maintain anxiety. In the long term, internal attention creates a selection history which biases future selection towards those anxiety-related mental representations, which is responsible in part for the long-term maintenance of anxiety.

If internal attention towards anxiety-related mental representations maintains the emotional experience of anxiety, then disengaging such attention would likely stop the emotional experience of anxiety (Koster *et alia*, 2011). Moreover, these mental representations are comprised of the anxiety-related thoughts, mental images, bodily sensations, urges, etc. currently in working memory. Therefore, fully disengaging attention from these mood-congruent thoughts, images, and other mental representations may eliminate or nearly eliminate the emotional experience of anxiety.

Cognitive Disengagement Technique

Many common existing therapeutic techniques aim to reduce engagement with negative thoughts, images, etc. such as mindfulness and cognitive defusion. However, they either do not fully disengage attention, do not fully distinguish between attention and awareness, or use distraction.

While defining the state of mindfulness is difficult because it is conceptualized quite differently depending on the context, such as in Buddhist texts and a Western research questionnaire (Chiesa, 2013), definitions of mindfulness commonly include

paying attention to the present moment, on purpose, and non-judgmentally (Kabat-Zinn, 1994, 2003). Reviews on mechanisms of mindfulness define mindfulness as involving conscious attention to one's moment-to-moment experience (Brown & Ryan, 2003; Shapiro, Carlson, Astin, & Freedman, 2006). One review of the mechanisms of mindfulness based on Buddhist texts and approaches specifically compares concentration and mindfulness and argues that they differ not in the degree or intensity of attention, but rather differ in what components of a thought or stimuli are being attended to. (Grabovac, Lau, & Willett, 2011). Moreover, according to that review, both practices involve focused, direct, attention towards thoughts, images, physical sensations, external stimuli, etc. Both, as the authors argue, reduce mental proliferation and rumination related to the original thoughts, images, external stimuli, etc. Other reviews note that a core component of mindfulness is experiential processing, involving attention to internal (thoughts, images) or external stimuli, without attempting to draw attention to it (Brown, Ryan, & Creswell, 2007; Good *et alia*, 2016; Teasdale, 1999). In Vipassana practice, a very common form of mindfulness, attention is applied to one's bodily sensations, thoughts, emotions, and surrounding environment (Bodhi, 2012; Davis & Hayes, 2011; Germer, 2005; Germer, Siegel, & Fulton, 2005; Gunaratana, 2011; Wallace, 2001; S. Young, 2016). Lastly, the use of attention to monitor one's present moment experiences is a component of mindfulness commonly described across mindfulness definitions and measures (Lindsay & Creswell, 2017; Quaglia, Brown, Lindsay, Creswell, & Goodman, 2015). In summary, a core component of mindfulness is drawing attention to internal or external stimuli without attempting to draw meaning from it. While mindfulness does reduce engagement with thoughts, images, urges, etc. by stopping rumination, it does not stop direct attention towards those thoughts or makes use of distraction, such as when watching one's breath.

Treatments that place a large emphasis on mindfulness, such as mindfulness-based cognitive therapy and Acceptance and Commitment Therapy (ACT) may therefore not fully disengage attention. In ACT, for example, cognitive defusion is put forward as a core component of mindfulness and the therapeutic approach. One popular introduction to ACT, *ACT Made Simple*, defines defusion as watching thoughts, such as watching cars go by, without getting tangled up in them (Harris, 2019). Moreover, a key component of cognitive defusion involves focused attention to the process of thinking or speaking without trying to draw meaning from the thoughts (Blackledge, 2007). While focusing on the process of thinking or speaking may decrease rumination and could carry other psychological benefits, it still involves focused attention towards emotion-related thoughts, images, urges, etc. Therefore, existing disengagement techniques such as mindfulness and cognitive defusion may not fully disengage attention from emotion-related thoughts, images, urges, etc.

Distraction is one technique that is often successful at reducing emotional intensity (Mikels & Reuter-Lorenz, 2019; Vytal *et alia*, 2012). While it is useful in certain instances, it is not feasible or preferable to do all the time, especially when someone has anxious thoughts and feelings throughout much of the day. For example, if someone has anxious thoughts throughout much of the day and focuses on their breath every time, they may have to focus on their breath for several hours each day. They would likely run into issues of fatigue and a lack of motivation. In other instances, distraction may affect the performance of a certain task. Simply put, while distraction is certainly useful in some contexts, it is unreasonable to expect distraction to be a stand-alone technique for reducing anxiety throughout much of an individual's day, especially when the individual worries/ruminates and has anxiety for several hours a day.

Other techniques that aim to fully disengage attention are often not effective or not sustainable. For example, suppression of thoughts is ineffective at disengaging attention and can even make thoughts more accessible than without suppression (Wenzlaff & Wegner, 2000). This is consistent with information on working memory and awareness in that holding a representation about something in internal attention keeps it in awareness (Amir & Bernstein, 2021), so trying to force a thought out of awareness brings attention to it and therefore keeps it in awareness (Greenberg, 2020b). Therefore, trying to push a thought or mental image out of awareness is not conducive to attention disengagement and keeps it in attention.

One technique that in part aims to disengage attention more effectively is the Cognitive Disengagement Technique (CDT). The CDT is a novel technique developed by Dr. Michael J. Greenberg as part of a modification on Exposure and Response Prevention (ERP) for OCD called Rumination-Focused ERP (RF-ERP) (Grattery & Greenberg, 2022). This approach aims to reduce mental engagement with obsessive material more than traditional ERP. The CDT is a central component of the approach, where individuals learn how to stop engagement with obsession-related thoughts, images, etc., in part by stopping focused attention towards those distressing thoughts and images. For example, someone struggling with checking their locks would learn how to stop paying direct, focused attention to thoughts related to whether their door is locked by learning the CDT. However, while this exercise is a central component of RF-ERP, it is not used as a standalone treatment. Much of the rest of the therapy is dedicated to addressing the reasons people have for ruminating and fixing on distressing thoughts. For example, RF-ERP includes a core psychodynamic component which aims to address justifications individuals hold to continue engaging with distressing internal material and associated behavior (Grattery & Greenberg, 2022).

Crucial to the CDT is the distinction between internally focused attention and an awareness of thoughts, images, urges, etc. (Greenberg, 2020b). With this distinction, patients are able to reduce attention towards the distressing thoughts until awareness is left and anxiety is eliminated or nearly eliminated. Notably, mental phenomena such as thoughts are not pushed out of awareness as they are during thought suppression. By using the CDT, patients are taught to lower their anxiety to approximately 0 before, during, and after exposures (Greenberg, 2021). They also do not move to more distressing exposures until they can use the CDT to limit their anxiety to a 0 or 1 in the current exposure (Greenberg, 2021). In learning this technique, patients are paired with a trained therapist until they are able to stop the 6 cognitive engagements on their own. Patients can usually independently use the technique within 2-3 sessions. Therefore, not being able to immediately disengage attention and other forms of mental engagement should not be seen as a failure of the technique.

The CDT defines 6 cognitive behaviors as mental engagement which need to be stopped or reduced in order to lower feelings of anxiety: (1) Trying to figure something out ('rumination proper'); (2) Directing attention/monitoring (this includes direct and focused controllable attentional engagement which contrasts with uncontrollable attentional capture and awareness); (3) Directing attention towards the possibility of threat (keeping one's guard up); (4) Thought suppression; (5) Using mindfulness or bad distraction; and (6) Engaging in self-talk

In contrast to previously mentioned techniques such as mindfulness, one major goal of the CDT is to disengage attention, but not awareness, from distressing thoughts, mental images, and urges. Moreover, one central hypothesis of Michael Greenberg, the

creator of RF-ERP and the CDT, is that by stopping all cognitive engagement including attention, but not awareness of the thought, image, or urge, anxiety is reduced to approximately 0 (Greenberg, 2020c, 2021). Therefore, because the CDT teaches people to stop paying focused attention towards distressing mental representations, it is a good candidate for testing whether stopping attention can stop certain emotional responses. Moreover, it does not suppress mental representations because it does not attempt to push them out of awareness. Drawing from the earlier section on the role of attention in emotion maintenance through working memory and internal attention, this leads to the main hypothesis:

Internal attention towards anxiety-related mental representations such as anxious thoughts, images, bodily sensations, urges, etc. is necessary for the emotional experience of anxiety in normal instances. Disengaging attention until only awareness towards these mental representations remains will eliminate or nearly eliminate anxiety. The Cognitive Disengagement Technique, when fully applied, disengages attention until only awareness towards anxiety-related thoughts, mental images, bodily sensations, urges, etc. remains, and eliminates or nearly eliminates feelings of anxiety.

Anxiety in this case refers specifically to the emotional experience of anxiety, defined as the feeling that occurs when the threat is uncertain or distal in space or time (LeDoux & Pine, 2016). This is in contrast to fear, which is the feeling that occurs when the threat is imminent or immediate (LeDoux & Pine, 2016). In addition, feelings of anxiety differ from physiological changes due to threatening thoughts or images (LeDoux & Pine, 2016). Moreover, anxiety is a response to unknown threat or internal conflict, while fear is focused on known external danger (Barlow, 2000; Craig, Brown, & Baum, 1995; Steimer, 2002). Paying attention to mental representations of threat or internal conflict requires internal attention (Chun, Golomb, & Turk-Browne, 2011). Indeed, this distinction between fear and anxiety is important precisely because the hypothesis above pertain to internal attention, not external attention. Therefore, while this paper argues that disengaging internal attention from anxiety-related mental representations significantly reduces anxiety, it extends no such hypothesis to when the threat is certain and in external attention, producing fear responses. For example, someone who is afraid of touching a doorknob in public because it might be contaminated is not afraid of the doorknob, but instead feels anxiety from the possibility of it being contaminated and the risks that possibility contains. With that said, many instances of fear involve feelings of anxiety and mental representations such as thoughts and mental images. For example, someone rock climbing may think about the drop even when they are not looking down or may imagine themselves falling while looking down. In this case, attention disengagement from anxiety-related thoughts, images, etc. would still likely be useful for reducing anxiety despite the persistence of fear.

In summary, this paper hypothesizes that attention, but not awareness, towards emotion-congruent thoughts, mental images, bodily sensations, etc. maintains anxiety. By extension, disengaging from attention, but not awareness, stops the maintenance of anxiety and eliminates or nearly eliminates feelings of anxiety. This paper presents a highly testable hypothesis by citing the Cognitive Disengagement Technique, a technique that is argued in this paper to disengage attention but not awareness and is already used in OCD and anxiety treatment.

IMPLICATIONS

If disengaging attention and other mental engagements (other than awareness) eliminates or nearly eliminates feelings of anxiety, this would be an important psychological phenomenon that would have important implications for theories of emotion, research on extinction learning, and clinical approaches.

Notably, while the hypothesis proposed thus far in this paper mostly pertains to anxiety, much of the research supporting that hypothesis pertains to any emotion. Moreover, there is good evidence from several fields which suggest that the hypothesis can be generalized to other emotions. In fact, it is unlikely that a cognitive mechanism that is important for anxiety maintenance is unique to anxiety. For the mechanisms of anxiety maintenance to be unique to anxiety, the production of anxiety would likely have to involve different brain regions, networks, and basic psychological operations than other emotions (Touroutoglou *et alia*, 2015). In this locationist account (Touroutoglou *et alia*, 2015), different parts of the brain would be responsible for different emotions. Recent neuroscientific research, however, has found much stronger support for alternative accounts of emotion, in which emotions are the result of general brain networks made up of regions of the brain responsible for basic psychological operations, which are involved in both emotional and non-emotional states (Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012; Touroutoglou et alia, 2015). This research found little support for locationist approaches. Additionally, meta-analytic data supports a similar model called the network model, in which dynamic emergent processes produce emotional and non-emotional states (Pessoa, 2017, 2018). One example of this kind of network is the cortical-subcortical anatomical connection systems, in which brain regions such as the amygdala interact with the subcortical forebrain, the midbrain, and the brainstem, forming integrated networks that ultimately produce states such as emotion.

In both of these models, large-scale networks produce different emotional experiences (Barrett, 2012) and many of these networks are used for non-emotional experiences as well (Anderson, 2016). Certain parts of the brain, however, can be more highly activated in certain emotions. For example, areas of the brain such as the ventral anterior insula, caudate and thalamus associated with the salience network are more highly activated in negative emotions than positive emotions or resting states (Touroutoglou *et alia*, 2015). However, this is likely because those emotions use more of a certain domain-general function than other emotions (Saarimäki *et alia*, 2016; Tettamanti *et alia*, 2012), such as emotion salience in the example above.

One network that is involved in representing and distinguishing certain emotional experiences is the Default Mode Network, specifically hubs of the DMN such as the ventromedial prefrontal cortex (VMPFC), which is implicated in the production of affective states (Satpute & Lindquist, 2019; Sheline *et alia*, 2009). For example, the VMPFC and anterior cingulate cortex (ACC) are activated during anticipatory anxiety (Simpson, Drevets, Snyder, Gusnard, & Raichle, 2001). Notably, the DMN and hubs of the DMN such as the medial prefrontal cortex (MPFC) and the posterior cingulate cortex (PCC) are implicated in self-generated thought based on content recalled from memory (Andrews-Hanna, Smallwood, & Spreng, 2014; Konishi, McLaren, Engen, & Smallwood, 2015; Smallwood *et alia*, 2013; R. Smith *et alia*, 2018). PCC and ACC activity were positively correlated with depressive symptom scores during exposure to negative emotional information (Joormann & Tanovic, 2015), suggesting that those with depression recruit internally-directed attention more than healthy controls. Internally-directed

attention and self-generated thought are cognitive processes that play a mechanistic role in the maintenance of certain emotion states, as is argued in this paper.

Therefore, the areas and networks of the brain responsible for the production of anxiety are also involved in the production of emotional states such as sadness. Moreover, these networks and areas of the brain are implicated in basic psychological operations, such as internally-directed attention, self-generated thought, and memory recall, which are repeatedly cited in this paper as important mechanisms for the maintenance of many types of anxiety. Evidence from cognitive and clinical research points to similarities between mechanisms of anxiety and other emotions as well.

Repetitive thinking about negative information is a mechanism of negative mood in both anxiety and depression. Moreover, biases for the recall of negative information have been found in people with depressed mood and depression (Dillon & Pizzagalli, 2018; Gaddy & Ingram, 2014; Holmes, Blackwell, Heyes, Renner, & Raes, 2016; Joormann & Quinn, 2014) as well as in certain anxiety disorders (Ferreri, Lapp, & Peretti, 2011). Biases for the recall of negative information leads to greater negative mood through difficulties inhibiting negative information from entering attention, increasing rehearsal and rumination, and thereby exacerbating negative mood (Joormann, 2010). This process can involve working memory, which is an important mechanism in the production of anxiety and argued to be implicated in emotion regulation due to overlap within areas of the brain and within cognitive processes (Barkus, 2020). There is mixed evidence that working memory training increases mood and emotion regulation in both anxiety and depressed mood (Barkus, 2020; Gathercole, Dunning, Holmes, & Norris, 2019; Wanmaker, Geraerts, & Franken, 2015). Moreover, information in working memory has been found to amplify and extend emotional episodes. Mental imagery and imagination amplify the intensity of emotional episodes (Holmes, Geddes, Colom, & Goodwin, 2008; Verduyn & Lavrijsen, 2015; Zabelina, Clay, & Upshaw, 2021) and extend their length (Verduyn *et alia*, 2009; Verduyn & Lavrijsen, 2015). Across several different types of emotion, rumination is a very strong predictor of emotional intensity and length (Verduyn & Lavrijsen, 2015), and ruminative self-focus is highly associated with negative affect (Mor & Winquist, 2002). These findings suggest that cognitive engagement with emotion-relevant internal information maintains emotional episodes.

Therefore, similar brain networks, cognitive processes, and clinical markers are present in anxiety and other emotions. It is likely then that the hypothesis regarding the mechanistic role of attention in the emotional experience of anxiety is generalizable to other emotions.

Mirroring the distinction between fear and anxiety (LeDoux & Pine, 2016), disengaging internal attention is only relevant for mental representations, not external stimuli. For example, disengaging internal attention and using the CDT would likely not be effective at stopping feelings of disgust while the individual is looking at something disgusting. However, it may be effective at significantly reducing feelings of disgust while the individual is remembering and imagining something disgusting. Therefore, if an emotional experience is not preceded by a mood-maintaining event recently or currently in perceptual awareness, internal attention towards emotion-related mental representations such as emotion-related thoughts, images, bodily sensations, urges, etc. is important for the maintenance of that emotional experience. Disengaging attention until only awareness towards these mental representations remains may stop the maintenance of some of those emotional experiences. Moreover, the Cognitive Disengagement Technique, when properly and fully applied, disengages attention until only awareness towards emotion-

related thoughts, mental images, bodily sensations, urges, etc. remains, and may stop the maintenance of some of those emotional experiences.

It should be noted that emotions vary significantly in their duration, and the difference in duration cannot be fully explained by rumination or event importance (Verduyn & Lavrijsen, 2015). Rankings of emotion duration are generally consistent between studies (Scherer & Wallbott, 1994; Verduyn, Delaveau, Rotgé, Fossati, & Van Mechelen, 2015; Verduyn *et alia*, 2009; Verduyn & Lavrijsen, 2015). How long and to what degree feelings of an emotion last after no longer being maintained may rely on several factors, such as the type of emotion and the intensity of the emotional experience (Verduyn *et alia*, 2015). Therefore, the rate and degree to which the CDT and disengagement from mood-congruent mental representations lowers feelings of an emotion may differ significantly among emotions.

If disengagement stops the maintenance of emotions, this would certainly support hypotheses that the content of working memory maintains emotions (Joormann, 2010). It would also support models in which self-focused attention maintains feelings of anxiety (Clark & Wells, 1995). With that in mind, some authors argue that robust phenomena are needed to build strong theories by providing constraints that theories must take into account (Bechtel & Richardson, 2010; Eronen & Bringmann, 2021), and that constraining certain theories may be more important than how a phenomenon supports other theories (Eronen & Bringmann, 2021). One example of this would be the theory of constructed emotion (Hoemann, Gendron, & Barrett, 2017), in which cognition and emotion are the result of processes which predict how much bodily energy to use based on information such as sensory input. Simply put, if someone can use the CDT to not feel much anxiety in an environment that was previously highly predictive of anxiety (such as someone with contamination OCD in a public bathroom), then it would be unclear why the bathroom suddenly became less predictive and how attention towards mood-congruent mental representations could affect those prediction processes.

One of the clearest and most important implications of the hypothesis presented in this paper is for extinction learning and conditioning models of anxiety and their relevance for exposure therapy. Classical conditioning models of anxiety and fear acquisition involve a neutral stimulus called the Conditioned Stimulus (CS), that when paired with an aversive stimulus called the Unconditioned Stimulus (US), produces an aversive response called the Conditioned Response (CR) (such as fear or anxiety) when the CS is presented (Pittig, Treanor, LeBeau, & Craske, 2018). When the CS is presented, a memory association of the US is activated in some form, leading to the CR (Craske, 2015).

Habituation is one conditioning model which describes a reduction in the CR from an aversive CS after repeated presentations of the CS without the US (Groves & Thompson, 1970). While habituation likely plays a role in anxiety learning, it cannot fully explain spontaneous recovery of a CR after extinction (K. Myers & Davis, 2007). Inhibitory learning, on the other hand, is a model of anxiety learning that is thought to be a more central mechanism in improvements from exposure therapy than habituation (Bouton, 1993). Using a classical conditioning approach, inhibitory learning describes how a conditioned stimulus gains a second association during exposures and exposure therapy which inhibits the original conditioned stimulus-unconditioned stimulus (CS-US). This second association is a conditioned stimulus-no unconditioned stimulus (CS-noUS), which does not replace, but does inhibit the existing CS-US association (Pittig et alia, 2018). For example, someone who is afraid of public speaking and believes people

will laugh at them would deliver a speech even when anxious and may learn that what they feared did not actually happen. If that is the case, the CS-noUS association could be strengthened, inhibiting the CS-US association in future similar instances of public speaking.

If attention towards anxiety-related mental representations is necessary for feelings of anxiety and attention can be sufficiently disengaged, then this could present important developments for conditioning models of exposure therapy. One possible pathway through which attention disengagement could affect anxiety is that disengaging from mental representations related to the anxiety may involve disengaging from mental representations of the US. Authors in the field of extinction learning posit that memory representations of the CS and the US are connected such that presentations of the CS activate memory representations of the US, leading to the CR (Craske, 2015; Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). Moreover, it is the mental representation of the US that causes the conditioned negative feelings. If memory activation of the US is necessary for certain components of the CR, then this could explain how internal attention disengagement could reduce anxiety, a component of the CR. In other words, the memory association of the US may not be fully activated during disengagement, which may be necessary for certain CRs such as feelings of anxiety.

Moreover, attention disengagement such as the CDT could create an additional type of association, similar to the CS-noUS associations of inhibitory learning. If this is the case, a CS-noCR association could be formed (in addition to a CS-noUS association), inhibiting the existing CS-CR association. This would represent a form of operant conditioning where anxiety is reduced as long as individuals correctly apply the CDT. In the public speaking example, if the speaker did not engage with anxiety-related thoughts, they may not feel much anxiety and could be building a CS-noCR association where they would learn that they do not need to feel anxiety during public speaking. Stopping mental engagements with anxiety-related mental representations may also strengthen CS-noUS associations because US-related thoughts, images, etc. may re-activate CS-US associations during and outside exposures, such as during rumination (Marks, Walker, Ojalehto, Bedard-Gilligan, & Zoellner, 2019; McEvoy, Watson, Watkins, & Nathan, 2013). In particular, the relationship between mental engagement and the CS-US association is likely related to the role of rehearsal in learning and memory. Rehearsal is important for associative memory and is theorized to strengthen memory associations (Meeter & Murre, 2004). Repetitive thought, including worry, can rehearse the CS-US relationship and strengthen it, resulting in a greater CR (Joos, Vansteenwegen, & Hermans, 2012). Mental engagement with the US during a presentation of the CS may therefore strengthen the CS-US memory association through rehearsal.

Another use of the CDT is that because it focuses on eliminating or nearly eliminating anxiety responses before, during, and after exposures, it may have greater adherence. While Exposure and Response Prevention (ERP) has similar (Ong, Clyde, Bluett, Levin, & Twohig, 2016) or even lower (Johnco, McGuire, Roper, & Storch, 2020) rates of dropout than other treatments, the CDT may increase compliance further because it may be less distressing than traditional exposures.

Therefore, if disengaging attention does stop the maintenance of anxiety and certain other emotions, this would present highly important developments in the science of extinction learning and exposure therapy. Notably, these developments would likely not be relevant only for anxiety; classical and operant conditioning models and exposure-based techniques are relevant for a wide variety of psychopathology such as

depressive disorders (Marks *et alia*, 2019), which involve many different emotions than fear or anxiety. Emotion dysregulation is often argued to be a core component of mood and anxiety disorders (Hofmann, Sawyer, Fang, & Asnaani, 2012). Internal attention disengagement could therefore be an effective form of emotion regulation for a variety of emotions and disorders. Moreover, the CDT could be an effective way to stop patterns of negative thinking such as rumination or worry, both of which are implicated in various disorders (K. S. Young, Sandman, & Craske, 2019). Therefore, attention disengagement could present an important component of treatment for a variety of psychopathology. It is important to note that the CDT is one part of RF-ERP, which includes psychodynamic and some components used in motivational interviewing that target people's justifications for engaging with emotion-relevant internal material such as thoughts, mental images, or urges. This is a central component of the therapy. In some ways, this is similar to Metacognitive Therapy's approach which aims to change people's beliefs about the usefulness and relevance of worry and rumination (Wells, 2011).

As the CDT and RF-ERP are commonly used in OCD treatment, the CDT and attention disengagement may especially be important for thoughts that feel difficult to stop or control. OCD is characterized by disturbing thoughts and images that are difficult to stop (American Psychiatric Association, 2022). In addition, mental imagery plays an important role in maintaining anxiety states in PTSD and social phobia (Hackmann & Holmes, 2004; Hirsch & Holmes, 2007). Mental images in psychopathology related to PTSD, for instance, are described as being recalled involuntarily, capturing attention away from other current tasks (Conway, 2001). Like disturbing thoughts, disengaging attention from mental imagery may therefore be important for stopping the maintenance of anxiety states in PTSD and social phobia. By learning how to stop engaging with thoughts, including attentional engagement (but not stopping awareness), and by addressing the justifications of continuing engagement with obsessions, RF-ERP aims to get patients to regain control of thoughts and images that feel difficult to control (Greenberg, 2020a).

Of course, whether an emotional experience can or should be stopped by attentional disengagement are important considerations for clinical practice. Emotions, even highly distressing ones, are in many cases useful and natural reactions (Hershfield, Scheibe, Sims, & Carstensen, 2013; Shear, 2012). Attempting to suppress certain emotions can lead to further distress and is associated with a prevalence of mental disorders (Dryman & Heimberg, 2018; Zanarini, Weingeroff, & Frankenburg, 2009). Moreover, certain emotions such as grief may be too strong to disengage from fully or may cause mood changes even when the individual is not thinking about the loss. Figuring out which emotional instances can and should be disengaged from to stop their maintenance is therefore an important task for clinicians who attempt this approach.

Other clinical implications may include disorders such as insomnia. People with insomnia differ from healthy controls in the content of their thoughts, by worrying more and focusing more on not sleeping (Harvey, 2000). Their thoughts and mental images also feel more intrusive and sleep-disturbing than the thoughts and mental images of healthy controls (Harvey, 2000). Disengaging from their thoughts and images could help people with insomnia because negative thought patterns such as rumination and worry help maintain sleep disturbances (Carney, Harris, Falco, & Edinger, 2013; Guastella & Moulds, 2007; Pillai & Drake, 2015). In other words, if an individual with insomnia disengages attention, but not awareness, from thoughts and mental images that prevent them from sleeping, they may somewhat improve their insomnia.

Tics and urges are highly associated with OCD (Brandt *et alia*, 2018; McKay *et alia*, 2004). In particular, premonitory urges, defined as uncomfortable sensory feelings or rising tensions before a tic or compulsive behavior, are heavily implicated in both tics (Capriotti, Brandt, Turkel, Lee, & Woods, 2014) and many OCD compulsions (Brandt *et alia*, 2018; Ferrão *et alia*, 2012). Moreover, urge intensity predicts compulsion execution, such that the more intense an urge is, the more likely a compulsion will soon happen (Brandt et alia, 2018). For example, premonitory urges in skin picking are thought to maintain compulsive behavior, similar to some types of Gilles de la Tourette syndrome and OCD (Brandt *et alia*, 2018; Capriotti *et alia*, 2014; Dieringer *et alia*, 2019). Suppression temporarily reduces urge intensity, reducing compulsive behavior such as skin picking (Dieringer *et alia*, 2019). Suppression may decrease urge intensity and tic frequency due to the connection between attention and tic frequency.

Tasks which capture attention and focus such as the Trier Social Stress Test decrease tic frequency in tic disorders (Buse, Enghardt, Kirschbaum, Ehrlich, & Roessner, 2016; Misirlisoy *et alia*, 2015). The object of attention seems to be important, as tic-related cognitions increase tic frequency and urge intensity, and are self-reported as triggering tics by individuals with tic disorders (Herrmann *et alia*, 2019; O'Connor, St-Pierre-Delorme, Leclerc, Lavoie, & Blais, 2014). Lastly, individuals with tic disorders and OCD together display especially high deficits in sustained attention, suggesting that tics capture attention, especially for those with OCD (Lucke *et alia*, 2015). If attention towards tics and urges increases urge intensity and tic frequency, then disengaging attention may reduce urge intensity and tic frequency. Moreover, as suppression can reduce urge intensity (Dieringer *et alia*, 2019), a technique such as the CDT which disengages attention may reduce urge intensity even more. In fact, the CDT is used in the treatment of tics and urges associated with OCD (Greenberg, 2020d). This could have important implications for reducing the intensity of premonitory urges present in OCD and tic disorders.

Future Directions

The hypotheses presented in this paper lack testing. Therefore, it is paramount to study the CDT and test these hypotheses. One clear way to test the effectiveness of disengagement and the CDT on emotional intensity is by testing the effect of the CDT on feelings of anxiety before, during, and after exposures. Studies which compare the CDT with similar techniques such as cognitive defusion and mindfulness could more carefully test the differences between these techniques. Moreover, the CDT is hypothesized to reduce emotional inertia in other emotions, so studies which test the effect of the CDT on the length and intensity of emotions could be useful. Clinical studies measuring the effect of RF-ERP and the CDT on OCD and anxiety disorders would be the next step. Then, if those are successful, it would make sense to expand clinical trials to other disorders.

One challenging but important future step for researching the CDT is to measure the effect of the CDT on internal attention. While it was assumed that the CDT reduces internal attention, it isn't clear to what degree it does. This is challenging to measure due to the innate methodological difficulties of studying the focus and degree of internal attention (Amir, Ruimi, & Bernstein, 2021). The fact that the CDT disengages attention only from emotion-relevant mental representations raises additional problems. It does not disengage internal attention broadly from all mental representations (Verduyn *et*

alia, 2015). Therefore, a method to determine how much the CDT disengages internal attention would somehow have to isolate emotion-relevant mental representations for study. Moreover, the CDT does not disengage awareness from emotion-congruent thoughts, images, etc. So, distinguishing between internal awareness and internal attention runs into similar problems as studying internal attention.

Given the connection between working memory capacity and attentional control (Baddeley, 1992), it is possible that people with better working memory capacity and attentional control may find using the CDT easier, given that the CDT involves controlling attention. Moreover, because working memory capacity is higher in healthy controls than anxious and depressed individuals (Joormann & Gotlib, 2008; Qi et alia, 2014; Sari, Koster, & Derakshan, 2017) and people with better emotion regulation ability have greater WMC than anxious individuals (Schmeichel, Volokhov, & Demaree, 2008), healthy controls may be more effective at using aspects of the CDT including attention disengagement. They may also use them more regularly than anxious and depressed individuals. Studies could measure the time to learn or self-reported difficulty of learning the CDT. Moreover, since the CDT could be used for disengaging from thoughts and images that feel intrusive, it may affect the perceived intrusiveness of those thoughts and images. Analyses of perceived intrusiveness before and after RF-ERP or learning and using the CDT could test how these techniques affect the perceived intrusiveness of disturbing thoughts and images, especially in OCD.

It was noted earlier in this paper that the CDT is likely not effective at getting rid of fear because fear involves perceptual stimuli, which are not the subject of internal attention. This would be an important hypothesis to test, although it runs into some challenges. First, situations involving fear still involve mental representations in working memory such as thoughts, mental images, etc. that contribute to distress, and disengaging attention from those thoughts and images may reduce distress. Second, the precise distinction between fear and anxiety is still up for debate (Daniel-Watanabe & Fletcher, 2022; Perusini & Fanselow, 2015), and experimental designs which use highly similar conditions for fear and anxiety run the risk of not truly creating distinct conditions. However, if the CDT is effective at reducing distress from mental representations but not perceptual stimuli, it could be used as a method to determine whether an emotional state is predominately from external or internal stimuli.

In conclusion, there is a strong base of evidence connecting attention to working memory and suggesting that the content of working memory and attention maintain anxiety and other emotions. A technique which disengages attention (but not awareness) is therefore a promising approach to testing the effect of disengagement on anxiety and certain other emotions. The potential implications for basic science and treatment are highly significant.

REFERENCES

Aldao A, Sheppes G, & Gross JJ (2015). Emotion Regulation Flexibility. *Cognitive Therapy and Research, 39*, 263-278. Doi: 10.1007/s10608-014-9662-4

American Psychiatric Association. (2022). *Diagnostic and statistical manual of mental disorders* (5th ed, text rev.) Washington, DC: American Psychiatric Association.

Amir I & Bernstein A (2021). *Dynamics of Internal Attention and Internally-Directed Cognition: The Attention-to-Thoughts (A2T) Model* [Preprint]. *PsyArXiv*. Doi: 10.31234/osf.io/3qpgb

Amir I, Ruim L, & Bernstein A (2021). Simulating thoughts to measure and study internal attention in mental health. *Scientific Reports, 11*, 2251. Doi: 10.1038/s41598-021-81756-w

Anderson ML (2016). Précis of After Phrenology: Neural Reuse and the Interactive Brain. *Behavioral and Brain Sciences, 39*, e120. Doi: 10.1017/S0140525X15000631

Andrewes DG & Jenkins LM (2019). The Role of the Amygdala and the Ventromedial Prefrontal Cortex in Emotional Regulation: Implications for Post-traumatic stress disorder. *Neuropsychology Review, 29*, 220-243. Doi: 10.1007/s11065-019-09398-4

Andrews-Hanna JR, Smallwood J, & Spreng RN (2014). The default network and self-generated thought: component processes, dynamic control, and clinical relevance. *Annals of the New York Academy of Sciences, 1316*, 29-52. Doi: 10.1111/nyas.12360

Aoki R, Sato H, Katura T, Utsugi K, Koizumi H, Matsuda R, & Maki A (2011). Relationship of negative mood with prefrontal cortex activity during working memory tasks: An optical topography study. *Neuroscience Research, 70*, 189-196. Doi: 10.1016/j.neures.2011.02.011

Ashcraft MH & Kirk EP (2001). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General, 130*, 224-237. Doi: 10.1037/0096-3445.130.2.224

Awh E, Anllo-Vento L, & Hillyard SA (2000). The Role of Spatial Selective Attention in Working Memory for Locations: Evidence from Event-Related Potentials. *Journal of Cognitive Neuroscience, 12*, 840-847. Doi: 10.1162/089892900562444

Awh E & Jonides J (2001). Overlapping mechanisms of attention and spatial working memory. *Trends in Cognitive Sciences, 5*, 119-126. Doi: 10.1016/S1364-6613(00)01593-X

Baddeley A (1992). Working Memory. *Science, 255*(5044), 556-559. Doi: 10.1126/science.1736359

Balderston NL, Flook E, Hsiung A, Liu J, Thongarong A, Stahl S, Makhoul W, Sheline Y, Ernst M, & Grillon C (2020). Patients with anxiety disorders rely on bilateral dlPFC activation during verbal working memory. *Social Cognitive and Affective Neuroscience, 15*, 1288-1298. Doi: 10.1093/scan/nsaa146

Balderston NL, Vytal KE, O'Connell K, Torrisi S, Letkiewicz A, Ernst M, & Grillon C (2017). Anxiety Patients Show Reduced Working Memory Related dlPFC Activation During Safety and Threat. *Depression and Anxiety, 34*, 25-36. Doi: 10.1002/da.22518

Bandelow B & Michaelis S (2015). Epidemiology of anxiety disorders in the 21st century. *Dialogues in Clinical Neuroscience 17*, 327-335. Doi: 10.31887/DCNS.2015.17.3/bbandelow

Barkus E (2020). Effects of working memory training on emotion regulation: Transdiagnostic review. *PsyCh Journal, 9*, 258-279. Doi: 10.1002/pchj.353

Barlow DH (2000). Unraveling the mysteries of anxiety and its disorders from the perspective of emotion theory. *The American Psychologist, 55*, 1247-1263. Doi: 10.1037//0003-066x.55.11.1247

Barrett LF (2012). Emotions are real. *Emotion, 12*, 413-429. Doi: 10.1037/a0027555

Barrett LF, Mesquita B, Ochsner KN, & Gross JJ (2007). The Experience of Emotion. *Annual Review of Psychology, 58*, 373-403. Doi: 10.1146/annurev.psych.58.110405.085709

Bechtel W & Richardson RC (2010). *Discovering Complexity: Decomposition and Localization as Strategies in Scientific Research*. Cambridge, MA: MIT Press.

Beckwé M, Deroost N, Koster EHW, De Lissnyder E, & De Raedt R (2014). Worrying and rumination are both associated with reduced cognitive control. *Psychological Research, 78*, 651-660. Doi: 10.1007/s00426-013-0517-5

Berggren N & Derakshan N (2013). Attentional control deficits in trait anxiety: Why you see them and why you don't. *Biological Psychology, 92*, 440-446. Doi: 10.1016/j.biopsycho.2012.03.007

Blackledge JT (2007). Disrupting Verbal Processes: Cognitive Defusion in Acceptance and Commitment Therapy and Other Mindfulness-Based Psychotherapies. *The Psychological Record, 57*, 555-576. Doi: 10.1007/BF03395595

Bodhi B (2012). *Comprehensive Manual of Abhidhamma*: *The Abhidhammattha Sangaha*. Onalaska, WA: Pariyatti Publishing.

Boehme S, Miltner WHR, & Straube T (2015). Neural correlates of self-focused attention in social anxiety. *Social Cognitive and Affective Neuroscience, 1*, 856-862. Doi: 10.1093/scan/nsu128

Bögels SM & Mansell W (2004). Attention processes in the maintenance and treatment of social phobia: hypervigilance, avoidance and self-focused attention. *Clinical Psychology Review, 24*, 827-856. Doi: 10.1016/j.cpr.2004.06.005

Bögels SM, Rijsemus W, & De Jong PJ (2002). Self-Focused Attention and Social Anxiety: The Effects of Experimentally Heightened Self-Awareness on Fear, Blushing, Cognitions, and Social Skills. *Cognitive Therapy and Research, 26*, 461-472. Doi: 10.1023/A:1016275700203

Bonanno GA & Burton CL (2013). Regulatory Flexibility: An Individual Differences Perspective on Coping and Emotion Regulation. *Perspectives on Psychological Science, 8*, 591-612. Doi: 10.1177/1745691613504116

Bouton ME (1993). Context, time, and memory retrieval in the interference paradigms of Pavlovian learning. *Psychological Bulletin, 114*, 80. Doi: 10.1037/0033-2909.114.1.80

Brandt VC, Hermanns J, Beck C, Bäumer T, Zurowski B, & Münchau A (2018). The temporal relationship between premonitory urges and covert compulsions in patients with obsessive-compulsive disorder. *Psychiatry Research, 262*, 6-12. Doi: 10.1016/j.psychres.2018.01.041

Braunstein LM, Gross JJ, & Ochsner KN (2017). Explicit and implicit emotion regulation: a multi-level framework. *Social Cognitive and Affective Neuroscience, 12*, 1545-1557. Doi: 10.1093/scan/nsx096

Brown KW & Ryan RM (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*, 822-848. Doi: 10.1037/0022-3514.84.4.822

Brown KW, Ryan RM, & Creswell JD (2007). Mindfulness: Theoretical Foundations and Evidence for its Salutary Effects. *Psychological Inquiry, 18*, 211-237. Doi: 10.1080/10478400701598298

Brozovich F & Heimberg RG (2008). An analysis of post-event processing in social anxiety disorder. *Clinical Psychology Review, 28*, 891-903. Doi: 10.1016/j.cpr.2008.01.002

Buse J, Enghardt S, Kirschbaum C, Ehrlich S, & Roessner V (2016). Tic Frequency Decreases during Short-term Psychosocial Stress - An Experimental Study on Children with Tic Disorders. *Frontiers in Psychiatry, 7*. Doi: 10.3389/fpsyt.2016.00084

Cabeza R, Ciaramelli E, Olson IR, & Moscovitch M (2008). The parietal cortex and episodic memory: an attentional account. *Nature Reviews Neuroscience, 9*, 613-625. Doi: 10.1038/nrn2459

Capriotti MR, Brandt BC, Turkel JE, Lee HJ, & Woods DW (2014). Negative Reinforcement and Premonitory Urges in Youth with Tourette Syndrome: An Experimental Evaluation. *Behavior Modification, 38*, 276-296. Doi: 10.1177/0145445514531015

Carney CE, Harris AL, Falco A, & Edinger JD (2013). The Relation between Insomnia Symptoms, Mood, and Rumination about Insomnia Symptoms. *Journal of Clinical Sleep Medicine, 9*, 567-575. Doi: 10.5664/jcsm.2752

Chiesa A (2013). The Difficulty of Defining Mindfulness: Current Thought and Critical Issues. *Mindfulness, 4*, 255-268. Doi: 10.1007/s12671-012-0123-4

Chun MM, Golomb JD, & Turk-Browne NB (2011). A Taxonomy of External and Internal Attention. *Annual Review of Psychology, 62*, 73-101. Doi: 10.1146/annurev.psych.093008.100427

Chun MM & Johnson MK (2011). Memory: Enduring Traces of Perceptual and Reflective Attention. *Neuron, 72*, 520-535. Doi: 10.1016/j.neuron.2011.10.026

Clark DM & Wells A (1995). A cognitive model of social phobia. In RG Heimberg, MR Liebowitz, DA Hope, & FR Schneier (Eds.), *Social phobia: Diagnosis, assessment, and treatment* (pp. 69-93). New York: The Guilford Press.

Clarke R & Johnstone T (2013). Prefrontal inhibition of threat processing reduces working memory interference. *Frontiers in Human Neuroscience, 7*. Doi: 10.3389/fnhum.2013.00228

Conway MA (2001). Sensory-perceptual episodic memory and its context: autobiographical memory. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences, 356*(1413), 1375-1384. Doi: 10.1098/rstb.2001.0940

Cottencin O, Gruat G, Thomas P, Devos P, Goudemand M, & Consoli S (2008). Directed forgetting in depression. *Journal of the International Neuropsychological Society, 14*, 895-899. Doi: 10.1017/S1355617708081186

Cowan N (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioral and Brain Sciences, 24*, 87-114. Doi: 10.1017/S0140525X01003922

Craig KJ, Brown KJ, & Baum A (1995). Environmental factors in the etiology of anxiety. In FE Bloom & DJ Kupfer (Eds.), *Psychopharmocology - The Fourth Generation of Progress* (pp. 1325-1339). New York: Raven Press.

Craske MG (2015). Optimizing Exposure Therapy for Anxiety Disorders: An Inhibitory Learning and Inhibitory Regulation Approach. *Verhaltenstherapie, 25*, 134-143. Doi: 10.1159/000381574

Craske MG, Treanor M, Conway CC, Zbozinek T, & Vervliet B (2014). Maximizing exposure therapy: An inhibitory learning approach. *Behaviour Research and Therapy, 58*, 10-23. Doi: 10.1016/j.brat.2014.04.006

Daniel-Watanabe L, & Fletcher PC (2022). Are Fear and Anxiety Truly Distinct? *Biological Psychiatry Global Open Science, 2*, 341-349. Doi: 10.1016/j.bpsgos.2021.09.006

Davis DM & Hayes JA (2011). What are the benefits of mindfulness? A practice review of psychotherapy-related research. *Psychotherapy, 48*, 198-208. Doi: 10.1037/a0022062

Dawson AF, Brown WW, Anderson J, Datta B, Donald JN, Hong K, Allan S, Mole TB, Jones PB, & Galante J (2020). Mindfulness-Based Interventions for University Students: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. *Applied Psychology: Health and Well-Being, 12*, 384-410. Doi: 10.1111/aphw.12188

Derakshan N & Eysenck MW (2009). Anxiety, Processing Efficiency, and Cognitive Performance: New Developments from Attentional Control Theory. *European Psychologist, 14*, 168-176. Doi: 10.1027/1016-9040.14.2.168

Desimone R & Duncan J (1995). Neural Mechanisms of Selective Visual Attention. *Annual Review of Neuroscience, 18*, 193-222. Doi: 10.1146/annurev.ne.18.030195.001205

D'Esposito M, Aguirre GK, Zarahn E, Ballard D, Shin RK, & Lease J (1998). Functional MRI studies of spatial and nonspatial working memory. *Cognitive Brain Research, 7*, 1-13. Doi: 10.1016/S0926-6410(98)00004-4

D'Esposito M & Postle BR (2015). The Cognitive Neuroscience of Working Memory. *Annual Review of Psychology, 66*, 115-142. Doi: 10.1146/annurev-psych-010814-015031

Diamond A (2013). Executive Functions. *Annual Review of Psychology, 64*, 135-168. Doi: 10.1146/annurev-psych-113011-143750

Dieringer M, Beck C, Verrel J, Münchau A, Zurowski B, & Brandt V (2019). Quality and temporal properties of premonitory urges in patients with skin picking disorder. *Cortex, 121*, 125-134. Doi: 10.1016/j.cortex.2019.08.015

Dillon DG & Pizzagalli DA (2018). Mechanisms of Memory Disruption in Depression. *Trends in Neurosciences, 41*, 137-149. Doi: 10.1016/j.tins.2017.12.006

Dryman MT & Heimberg RG (2018). Emotion regulation in social anxiety and depression: a systematic review of expressive suppression and cognitive reappraisal. *Clinical Psychology Review, 65*, 17-42. Doi: 10.1016/j.cpr.2018.07.004

Duncan J & Owen AM (2000). Common regions of the human frontal lobe recruited by diverse cognitive demands. *Trends in Neurosciences, 23*, 475-483. Doi: 10.1016/S0166-2236(00)01633-7

Duval ER, Javanbakht A, & Liberzon I (2015). Neural circuits in anxiety and stress disorders: a focused review. *Therapeutics and Clinical Risk Management, 11*, 115-126. Doi: 10.2147/TCRM.S48528

Ehring T & Watkins ER (2008). Repetitive Negative Thinking as a Transdiagnostic Process. *International Journal of Cognitive Therapy, 1*, 192-205. Doi: 10.1521/ijct.2008.1.3.192

Engle RW (2002). Working Memory Capacity as Executive Attention. *Current Directions in Psychological Science, 11*, 19-23. Doi: 10.1111/1467-8721.00160

Eronen MI & Bringmann LF (2021). The Theory Crisis in Psychology: How to Move Forward. Perspectives on *Psychological Science, 16*, 779-788. Doi: 10.1177/1745691620970586

Etkin A, Büchel C, & Gross JJ (2015). The neural bases of emotion regulation. *Nature Reviews Neuroscience, 16*, 11. Doi: 10.1038/nrn4044

Etkin A, Egner T, & Kalisch R (2011). Emotional processing in anterior cingulate and medial prefrontal cortex. *Trends in Cognitive Sciences, 15*, 85-93. Doi: 10.1016/j.tics.2010.11.004

Everaert J, Bernstein A, Joormann J, & Koster EHW (2020). Mapping Dynamic Interactions Among Cognitive Biases in Depression. *Emotion Review, 12*, 93-110. Doi: 10.1177/1754073919892069

Eysenck MW & Derakshan N (2011). New perspectives in attentional control theory. *Personality and Individual Differences, 50*, 955-960. Doi: 10.1016/j.paid.2010.08.019

Eysenck MW, Derakshan N, Santos R, & Calvo MG (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion, 7*, 336-353. Doi: 10.1037/1528-3542.7.2.336

Fan J & Posner M (2004). Human Attentional Networks. *Psychiatrische Praxis, 31*, 210-214. Doi: 10.1055/s-2004-828484

Fergus TA, Weinzimmer SA, Schneider SC, & Storch EA (2021). Associations between self-absorption and working memory capacity: A preliminary examination of a transdiagnostic process spanning across emotional disorders. *Journal of Anxiety Disorders, 83*, 102457. Doi: 10.1016/j.janxdis.2021.102457

Ferrão YA, Shavitt RG, Prado H, Fontenelle LF, Malavazzi DM, de Mathis MA, Hounie AG, Miguel EC, & do Rosário MC (2012). Sensory phenomena associated with repetitive behaviors in obsessive-compulsive disorder: An

exploratory study of 1001 patients. *Psychiatry Research, 197*, 253-258. Doi: 10.1016/j.psychres.2011.09.017
Ferreri F, Lapp LK, & Peretti, CS (2011). Current research on cognitive aspects of anxiety disorders. *Current Opinion in Psychiatry, 24*, 49-54. Doi: 10.1097/YCO.0b013e32833f5585
Friedman NP & Miyake A (2004). The Relations Among Inhibition and Interference Control Functions: A Latent-Variable Analysis. *Journal of Experimental Psychology: General, 133*, 101-135. Doi: 10.1037/0096-3445.133.1.101
Friedman NP & Miyake A (2017). Unity and diversity of executive functions: Individual differences as a window on cognitive structure. *Cortex, 86*, 186-204. Doi: 10.1016/j.cortex.2016.04.023
Gaddy MA & Ingram RE (2014). A meta-analytic review of mood-congruent implicit memory in depressed mood. *Clinical Psychology Review, 34*, 402-416. Doi: 10.1016/j.cpr.2014.06.001
Gathercole SE, Dunning DL, Holmes J, & Norris D (2019). Working memory training involves learning new skills. *Journal of Memory and Language, 105*, 19-42. Doi: 10.1016/j.jml.2018.10.003
Gaydukevych D, & Kocovski NL (2012). Effect of self-focused attention on post-event processing in social anxiety. *Behaviour Research and Therapy, 50*, 47-55. Doi: 10.1016/j.brat.2011.10.010
Gazzaley A & Nobre AC (2012). Top-down modulation: bridging selective attention and working memory. *Trends in Cognitive Sciences, 16*, 129-135. Doi: 10.1016/j.tics.2011.11.014
Germer CK (2005). Mindfulness: What Is It? What Does It Matter? In CK Germer, RD Siegel, & PR Fulton (Eds.) *Mindfulness and psychotherapy* (pp. 3-27). New York: The Guilford Press.
Germer CK, Siegel RD, & Fulton PR (2005). *Mindfulness and Psychotherapy*. New York: The Guilford Press.
Good DJ, Lyddy CJ, Glomb TM, Bono JE, Brown KW, Duffy MK, Baer RA, Brewer JA, & Lazar SW (2016). Contemplating Mindfulness at Work: An Integrative Review. *Journal of Management, 42*, 114-142. Doi: 10.1177/0149206315617003
Grabovac AD, Lau MA, & Willett BR (2011). Mechanisms of Mindfulness: A Buddhist Psychological Model. *Mindfulness, 2*, 154-166. Doi: 10.1007/s12671-011-0054-5
Grattery A & Greenberg MJ (2022). *The Cognitive Disengagement Technique: A New Technique For Reducing Cognitive Engagement with OCD Thoughts, Images, and Urges*. IOCDF 2022 Research Symposium. Available at https://iocdf.org/wp-content/uploads/2022/07/Cognitive-disengagement-A-new-technique-for-reducing-cognitive-engagement-with-obsessive-thoughts-images-and-urges.pdf
Greenberg MJ (2020a). *Targets and Rationales for RF-ERP Exposures*. Available at https://drmichaeljgreenberg.com/targets-and-rationales-for-rf-erp-exposures/
Greenberg, M. J. (2020b). *Awareness, Attention, Distraction, and Rumination*. Available at https://drmichaeljgreenberg.com/awareness-attention-distraction-and-rumination/
Greenberg, M. J. (2020c). *Defining Rumination*. Available at https://drmichaeljgreenberg.com/defining-rumination/
Greenberg, M. J. (2020d). *When You Have OCD but You're Not Afraid of Anything: Treating 'Just Right' OCD, Random Rituals, and Compulsive Behavior*. Available at https://drmichaeljgreenberg.com/when-you-have-ocd-but-youre-not-afraid-of-anything-treating-just-right-ocd-random-rituals-and-compulsive-behavior/
Greenberg, M. J. (2021). *Rumination-Focused ERP: Turning Exposure on its Head*. Available at https://drmichaeljgreenberg.com/rumination-focused-erp-turning-exposure-on-its-head/
Grisham JR, King BJ, Makkar SR, & Felmingham KL (2015). The contributions of arousal and self-focused attention to avoidance in social anxiety. *Anxiety, Stress, & Coping, 28*, 303-320. Doi: 10.1080/10615806.2014.968144
Groves PM & Thompson RF (1970). Habituation: A dual-process theory. *Psychological Review, 77,* 419. Doi: 10.1037/h0029810
Guastella AJ & Moulds ML (2007). The impact of rumination on sleep quality following a stressful life event. *Personality and Individual Differences, 42*, 1151-1162. Doi: 10.1016/j.paid.2006.04.028
Gunaratana BH (2011). *Mindfulness in Plain English: 20th Anniversary Edition*. Leicester: Wisdom Publications.
Gyurak A, Goodkind MS, Kramer JH, Miller BL, & Levenson RW. (2012). Executive functions and the down-regulation and up-regulation of emotion. *Cognition & Emotion, 26*, 103-118. Doi: 10.1080/02699931.2011.557291
Hackmann A, Clark DM, & McManus F (2000). Recurrent images and early memories in social phobia. *Behaviour Research and Therapy, 38*, 601-610. Doi: 10.1016/S0005-7967(99)00161-8
Hackmann A & Holmes E (2004). Reflecting on imagery: A clinical perspective and overview of the special issue of Memory on mental imagery and memory in psychopathology. *Memory, 12*, 389-402. Doi: 10.1080/09658210444000133
Harris R (2019). *ACT Made Simple: An Easy-To-Read Primer on Acceptance and Commitment Therapy*. Oakland,

CA: New Harbinger Publications.
Harvey AG (2000). Pre-sleep cognitive activity: A comparison of sleep-onset insomniacs and good sleepers. *British Journal of Clinical Psychology, 39*, 275-286. Doi: 10.1348/014466500163284
Hasher L, Zacks RT, & May CP (1999). Inhibitory control, circadian arousal, and age. In D Gopher & A Koriat (Eds.), *Attention and performance XVII: Cognitive regulation of performance: Interaction of theory and application* (pp. 653-675). Cambridge, MA: The MIT Press.
Hayes S, Hirsch C, & Mathews A (2008). Restriction of working memory capacity during worry. *Journal of Abnormal Psychology, 117*, 712-717. Doi: 10.1037/a0012908
Heimberg RG, Bruch MA, Hope DA, & Dombeck M (1990). Evaluating the states of mind model: Comparison to an alternative model and effects of method of cognitive assessment. *Cognitive Therapy and Research, 14*, 543-557. Doi: 10.1007/BF01173363
Heller W, Engels AS, Mohanty A, Herrington JD, Banich MT, & Miller GA (2008). Specificity of regional brain activity in anxiety types during emotion processing. *Brain and Cognition, 67*, 9-10. Doi: 10.1016/j.bandc.2008.02.115
Heller W, Nitschke JB, Etienne MA, & Miller GA (1997). Patterns of regional brain activity differentiate types of anxiety. *Journal of Abnormal Psychology, 106*, 376-385. Doi: 10.1037/0021-843X.106.3.376
Herrmann K, Sprenger A, Baumung L, Alvarez-Fischer D, Münchau A, & Brandt V (2019). Help or hurt? How attention modulates tics under different conditions. *Cortex, 120*, 471-482. Doi: 10.1016/j.cortex.2019.06.016
Hershfield HE, Scheibe S, Sims TL, & Carstensen LL (2013). When Feeling Bad Can Be Good: Mixed Emotions Benefit Physical Health Across Adulthood. *Social Psychological and Personality Science, 4*, 54-61. Doi: 10.1177/1948550612444616
Hertel PT & Gerstle M (2003). Depressive Deficits in Forgetting. *Psychological Science, 14*, 573-578. Doi: 10.1046/j.0956-7976.2003.psci_1467.x
Hirsch CR, Clark DM, Mathews A, & Williams R (2003). Self-images play a causal role in social phobia. *Behaviour Research and Therapy, 41*, 909-921. Doi: 10.1016/S0005-7967(02)00103-1
Hirsch CR & Holmes EA (2007). Mental imagery in anxiety disorders. *Psychiatry, 6*, 161-165. Doi: 10.1016/j.mppsy.2007.01.005
Hoemann K, Gendron M, & Barrett LF (2017). Mixed emotions in the predictive brain. Current Opinion in *Behavioral Sciences, 15*, 51-57. Doi: 10.1016/j.cobeha.2017.05.013
Hofmann SG (2007). Cognitive Factors that Maintain Social Anxiety Disorder: A Comprehensive Model and its Treatment Implications. *Cognitive Behaviour Therapy, 36*, 193-209. Doi: 10.1080/16506070701421313
Hofmann SG, Sawyer AT, Fang A, & Asnaani A (2012). Emotion dysregulation model of mood and anxiety disorders. *Depression and Anxiety, 29*, 409-416. Doi: 10.1002/da.21888
Hofmann SG, Sawyer AT, Witt AA, & Oh D (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 78*, 169-183. Doi: 10.1037/a0018555
Holmes EA, Blackwell SE, Heyes SB, Renner F, & Raes F (2016). Mental imagery in depression: Phenomenology, potential mechanisms, and treatment implications. *Annual Review of Clinical Psychology, 12*, 249-280. Doi: 10.1146/annurev-clinpsy-021815-092925
Holmes EA, Geddes JR, Colom F & Goodwin GM (2008). Mental imagery as an emotional amplifier: Application to bipolar disorder. *Behaviour Research and Therapy, 46*, 1251-1258. Doi: 10.1016/j.brat.2008.09.005
Hope DA, & Heimberg RG (1988). Public and Private Self-Consciousness and Social Phobia. *Journal of Personality Assessment, 52*, 626-639. Doi: 10.1207/s15327752jpa5204_3
Ikkai A & Curtis CE (2011). Common neural mechanisms supporting spatial working memory, attention and motor intention. *Neuropsychologia, 49,* 1428-1434. Doi: 10.1016/j.neuropsychologia.2010.12.020
Inzlicht M, Bartholow BD, & Hirsh JB (2015). Emotional foundations of cognitive control. *Trends in Cognitive Sciences, 19*, 126-132. Doi: 10.1016/j.tics.2015.01.004
Johnco C, McGuire JF, Roper T, & Storch EA (2020). A meta-analysis of dropout rates from exposure with response prevention and pharmacological treatment for youth with obsessive compulsive disorder. *Depression and Anxiety, 37*, 407-417. Doi: 10.1002/da.22978
Johnson MK, Reeder JA, Raye CL, & Mitchell KJ (2002). Second Thoughts versus Second Looks: An Age-Related Deficit in Reflectively Refreshing Just-Activated Information. *Psychological Science, 13*, 64-67. Doi: 10.1111/1467-9280.00411
Joormann J (2004). Attentional bias in dysphoria: The role of inhibitory processes. *Cognition & Emotion, 18*, 125-147. Doi: 10.1080/02699930244000480

Joormann J (2010). Cognitive Inhibition and Emotion Regulation in Depression. *Current Directions in Psychological Science, 19*, 161-166. Doi: 10.1177/0963721410370293

Joormann J & Gotlib IH (2008). Updating the contents of working memory in depression: Interference from irrelevant negative material. *Journal of Abnormal Psychology, 117*, 182-192. Doi: 10.1037/0021-843X.117.1.182

Joormann J, LeMoult J, Hertel PT, & Gotlib IH (2009). Training Forgetting of Negative Material in Depression. *Journal of Abnormal Psychology, 118*, 34-43. Doi: 10.1037/a0013794

Joormann J & Quinn ME (2014). Cognitive Processes and Emotion Regulation in Depression. *Depression and Anxiety, 31*, 308-315. Doi: 10.1002/da.22264

Joormann J, Siemer M, & Gotlib IH (2007). Mood regulation in depression: Differential effects of distraction and recall of happy memories on sad mood. *Journal of Abnormal Psychology, 116*, 484-490. Doi: 10.1037/0021-843X.116.3.484

Joormann J & Tanovic E (2015). Cognitive vulnerability to depression: examining cognitive control and emotion regulation. *Current Opinion in Psychology, 4*, 86-92. Doi: 10.1016/j.copsyc.2014.12.006

Joos E, Vansteenwegen D, & Hermans D (2012). Post-acquisition repetitive thought in fear conditioning: An experimental investigation of the effect of CS-US-rehearsal. *Journal of Behavior Therapy and Experimental Psychiatry, 43*, 737-744. Doi: 10.1016/j.jbtep.2011.10.011

Jurado MB & Rosselli M (2007). The Elusive Nature of Executive Functions: A Review of our Current Understanding. *Neuropsychology Review, 17*, 213-233. Doi: 10.1007/s11065-007-9040-z

Kabat-Zinn J (1994). *Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life*. London: Hachette Books.

Kabat-Zinn J (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*, 144. Doi: 10.1093/clipsy.bpg016

Kalisch R, Wiech K, Critchley HD, & Dolan RJ (2006). Levels of appraisal: A medial prefrontal role in high-level appraisal of emotional material. *NeuroImage, 30*, 1458-1466. Doi: 10.1016/j.neuroimage.2005.11.011

Kashdan TB & Roberts JE (2004). Social Anxiety's Impact on Affect, Curiosity, and Social Self-Efficacy During a High Self-Focus Social Threat Situation. *Cognitive Therapy and Research, 28,* 119-141. Doi: 10.1023/B:COTR.0000016934.20981.68

Kellermann TS, Sternkopf MA, Schneier FR, Habel U, Turetsky BI, Zilles K, & Eickhoff SB (2012). Modulating the processing of emotional stimuli by cognitive demand. *Social Cognitive and Affective Neuroscience, 7*, 263-273. Doi: 10.1093/scan/nsq104

Kim JJ & Jung MW (2006). Neural circuits and mechanisms involved in Pavlovian fear conditioning: A critical review. *Neuroscience & Biobehavioral Reviews, 30*, 188-202. Doi: 10.1016/j.neubiorev.2005.06.005

Knudsen EI (2007). Fundamental Components of Attention. *Annual Review of Neuroscience, 30*, 57-78. Doi: 10.1146/annurev.neuro.30.051606.094256

Konishi M, McLaren DG, Engen H, & Smallwood J (2015). Shaped by the Past: The Default Mode Network Supports Cognition that Is Independent of Immediate Perceptual Input. *PLOS ONE, 10*, e0132209. Doi: 10.1371/journal.pone.0132209

Koster EHW, De Lissnyder E, Derakshan N, & De Raedt R (2011). Understanding depressive rumination from a cognitive science perspective: The impaired disengagement hypothesis. *Clinical Psychology Review, 31*, 138-145. Doi: 10.1016/j.cpr.2010.08.005

Kuhl BA,& Chun MM (2014). Memory and attention. In AC Nobre & S Kastner (Eds.), *The Oxford handbook of attention* (pp. 806-836). New York: Oxford University Press.

LaBar KS, Gitelman DR, Parrish TB, & Mesulam MM (1999). Neuroanatomic Overlap of Working Memory and Spatial Attention Networks: A Functional MRI Comparison within Subjects. *NeuroImage, 10*, 695-704. Doi: 10.1006/nimg.1999.0503

Lavie N, Hirst A, de Fockert JW, & Viding E (2004). Load Theory of Selective Attention and Cognitive Control. *Journal of Experimental Psychology: General, 133*, 339-354. Doi: 10.1037/0096-3445.133.3.339

LeDoux JE & Pine DS (2016). Using Neuroscience to Help Understand Fear and Anxiety: A Two-System Framework. *American Journal of Psychiatry, 173*, 1083-1093. Doi: 10.1176/appi.ajp.2016.16030353

Lee S, Kim SJ, Kwon OB, Lee JH, & Kim JH (2013). Inhibitory networks of the amygdala for emotional memory. *Frontiers in Neural Circuits, 7*, 129. Doi: 10.3389/fncir.2013.00129

Lindquist KA, Wager TD, Kober H, Bliss-Moreau E, & Barrett LF (2012). The brain basis of emotion: A meta-analytic review. *The Behavioral and Brain Sciences, 35*, 121-143. Doi: 10.1017/S0140525X11000446

Lindsay EK & Creswell JD (2017). Mechanisms of mindfulness training: Monitor and Acceptance Theory (MAT). *Clinical Psychology Review, 51*, 48-59. Doi: 10.1016/j.cpr.2016.10.011

Lucke IM, Lin C, Conteh F, Federline A, Sung H, Specht M, & Grados MA (2015). Continuous performance test in pediatric obsessive-compulsive disorder and tic disorders: the role of sustained attention. *CNS Spectrums, 20*, 479-489. Doi: 10.1017/S1092852914000467

Mansell W, Clark DM, & Ehlers A (2003). Internal versus external attention in social anxiety: an investigation using a novel paradigm. *Behaviour Research and Therapy, 41*, 555-572. Doi: 10.1016/S0005-7967(02)00029-3

Marks EH, Walker RSW, Ojalehto H, Bedard-Gilligan MA, & Zoellner LA (2019). Affect Labeling to Facilitate Inhibitory Learning: Clinical Considerations. *Cognitive and Behavioral Practice, 26*, 201-213. Doi: 10.1016/j.cbpra.2018.05.001

McEvoy PM, Watson H, Watkins ER, & Nathan P (2013). The relationship between worry, rumination, and comorbidity: Evidence for repetitive negative thinking as a transdiagnostic construct. *Journal of Affective Disorders, 151*, 313-320. Doi: 10.1016/j.jad.2013.06.014

McKay D, Abramowitz JS, Calamari JE, Kyrios M, Radomsky A, Sookman,D, Taylor S, & Wilhelm S (2004). A critical evaluation of obsessive-compulsive disorder subtypes: Symptoms versus mechanisms. *Clinical Psychology Review, 24*, 283-313. Doi: 10.1016/j.cpr.2004.04.003

McLaughlin KA, Borkovec TD, & Sibrava NJ (2007). The Effects of Worry and Rumination on Affect States and Cognitive Activity. *Behavior Therapy, 38*, 23-38. Doi: 10.1016/j.beth.2006.03.003

McRae K (2016). Cognitive emotion regulation: a review of theory and scientific findings. *Current Opinion in Behavioral Sciences, 10*, 119-124. Doi: 10.1016/j.cobeha.2016.06.004

Meeter M & Murre JMJ (2004). Consolidation of Long-Term Memory: Evidence and Alternatives. *Psychological Bulletin, 130*, 843. Doi: 10.1037/0033-2909.130.6.843

Mikels JA & Reuter-Lorenz PA (2019). Affective Working Memory: An Integrative Psychological Construct. *Perspectives on Psychological Science, 14*, 543-559. Doi: 10.1177/1745691619837597

Mills AC, Grant DM, Judah MR, & White EJ (2014). The Influence of Anticipatory Processing on Attentional Biases in Social Anxiety. *Behavior Therapy, 45*, 720-729. Doi: 10.1016/j.beth.2014.04.004

Misirlisoy E, Brandt V, Ganos C, Tübing J, Münchau A, & Haggard P (2015). The relation between attention and tic generation in Tourette syndrome. *Neuropsychology, 29*, 658-665. Doi: 10.1037/neu0000161

Miyake A, Friedman NP, Emerson MJ, Witzki AH, Howerter,A, & Wager TD (2000). The Unity and Diversity of Executive Functions and Their Contributions to Complex "Frontal Lobe" Tasks: A Latent Variable Analysis. *Cognitive Psychology, 41,* 49-100. Doi: 10.1006/cogp.1999.0734

Mor N & Winquist J (2002). Self-focused attention and negative affect: A meta-analysis. *Psychological Bulletin, 128*, 638-662. Doi: 10.1037/0033-2909.128.4.638

Moran TP (2016). Anxiety and working memory capacity: A meta-analysis and narrative review. *Psychological Bulletin, 142*, 831-864. Doi: 10.1037/bul0000051

Moriya J & Sugiura Y (2012). Impaired Attentional Disengagement from Stimuli Matching the Contents of Working Memory in Social Anxiety. *PLOS ONE, 7*, e47221. Doi: 10.1371/journal.pone.0047221

Myers K & Davis M (2007). Mechanisms of fear extinction. *Molecular Psychiatry, 12*, Article 2. Doi: 10.1038/sj.mp.4001939

Myers N, Stokes, MG, & Nobre AC (2017). Prioritizing Information during Working Memory: Beyond Sustained Internal Attention. *Trends in Cognitive Sciences, 21*, 449-461. Doi: 10.1016/j.tics.2017.03.010

Naragon-Gainey K, McMahon TP, & Chacko TP (2017). The structure of common emotion regulation strategies: A meta-analytic examination. *Psychological Bulletin, 143*, 384-427. Doi: 10.1037/bul0000093

Newma MG, Llera SJ, Erickson TM, Przeworski A, & Castonguay LG (2013). Worry and Generalized Anxiety Disorder: A Review and Theoretical Synthesis of Evidence on Nature, Etiology, Mechanisms, and Treatment. *Annual Review of Clinical Psychology, 9*, 275-297. Doi: 10.1146/annurev-clinpsy-050212-185544

Niendam TA, Laird AR, Ray KL, Dean YM, Glahn DC, & Carter CS (2012). Meta-analytic evidence for a superordinate cognitive control network subserving diverse executive functions. *Cognitive, Affective, & Behavioral Neuroscience, 12*, 241-268. Doi: 10.3758/s13415-011-0083-5

Nobre AC & Stokes MG (2011). Attention and short-term memory: Crossroads. *Neuropsychologia, 49*, 1391-1392. Doi: 10.1016/j.neuropsychologia.2011.04.014

Nobre AC & Stokes MS (2020). Memory and Attention: The Back and Forth. In D Poeppel, GR Mangun, & MS Gazzaniga (Eds.), *The Cognitive Neurosciences* (6th ed.). Cambridge, MA: The MIT Press.

Norton AR & Abbott MJ (2016). Self-Focused Cognition in Social Anxiety: A Review of the Theoretical and Empirical Literature. *Behaviour Change, 33*, 44-64. Doi: 10.1017/bec.2016.2

Oberauer K (2019). Working Memory and Attention - A Conceptual Analysis and Review. *Journal of Cognition, 2,* Article 36. Doi: 10.5334/joc.58

Ochsner KN & Gross JJ (2005). The cognitive control of emotion. *Trends in Cognitive Sciences, 9*, 242-249. Doi: 10.1016/j.tics.2005.03.010

Ochsner KN, Silvers JA, & Buhle JT (2012). Functional imaging studies of emotion regulation: a synthetic review and evolving model of the cognitive control of emotion: Functional imaging studies of emotion regulation. *Annals of the New York Academy of Sciences, 1251*, E1-E24. Doi: 10.1111/j.1749-6632.2012.06751.x

O'Connor K, St-Pierre-Delorme MÈ, Leclerc J, Lavoie M, & Blais MT (2014). Meta-Cognitions in Tourette Syndrome, Tic Disorders, and Body-Focused Repetitive Disorder. *The Canadian Journal of Psychiatry, 59*, 417-425. Doi: 10.1177/070674371405900804

Olatunji BO, Naragon-Gainey K, & Wolitzky-Taylor KB (2013). Specificity of Rumination in Anxiety and Depression: A Multimodal Meta-Analysis. *Clinical Psychology: Science and Practice, 20*, 225-257. Doi: 10.1111/cpsp.12037

Ong CW, Clyde JW, Bluett EJ, Levin ME, & Twohig MP (2016). Dropout rates in exposure with response prevention for obsessive-compulsive disorder: What do the data really say? *Journal of Anxiety Disorders, 40*, 8-17. Doi: 10.1016/j.janxdis.2016.03.006

Opitz PC, Gross JJ, & Urry HL (2012). Selection, Optimization, and Compensation in the Domain of Emotion Regulation: Applications to Adolescence, Older Age, and Major Depressive Disorder: SOC-ER Applications. *Social and Personality Psychology Compass, 6*, 142-155. Doi: 10.1111/j.1751-9004.2011.00413.x

Owen AM, McMillan KM, Laird AR, & Bullmore E (2005). N-back working memory paradigm: A meta-analysis of normative functional neuroimaging studies. *Human Brain Mapping, 25*, 46-59. Doi: 10.1002/hbm.20131

Pashler H (1994). Dual-task interference in simple tasks: Data and theory. *Psychological Bulletin, 116*, 220-244. Doi: 10.1037/0033-2909.116.2.220

Paulesu E, Sambugaro E, Torti T, Danelli L, Ferri F, Scialfa G, Sberna M, Ruggiero GM, Bottini G, & Sassaroli S (2010). Neural correlates of worry in generalized anxiety disorder and in normal controls: a functional MRI study. *Psychological Medicine, 40*, 117-124. Doi: 10.1017/S0033291709005649

Perusini JN & Fanselow, M. S. (2015). Neurobehavioral perspectives on the distinction between fear and anxiety. *Learning & Memory, 22*, 417-425. Doi: 10.1101/lm.039180.115

Pessoa L (2008). On the relationship between emotion and cognition. *Nature Reviews Neuroscience, 9*, 148-158. Doi: 10.1038/nrn2317

Pessoa L (2017). A Network Model of the Emotional Brain. *Trends in Cognitive Sciences, 21*, 357-371. Doi: 10.1016/j.tics.2017.03.002

Pessoa L (2018). Understanding emotion with brain networks. *Current Opinion in Behavioral Sciences, 19*, 19-25. Doi: 10.1016/j.cobeha.2017.09.005

Pillai V & Drake CL (2015). Sleep and Repetitive Thought: The Role of Rumination and Worry in Sleep Disturbance. In KA Babson & MT Feldner (Eds.), *Sleep and Affect* (pp. 201-225). Academic Press. Doi: 10.1016/B978-0-12-417188-6.00010-4

Pittig A, Treanor M, LeBeau RT, & Craske MG (2018). The role of associative fear and avoidance learning in anxiety disorders: Gaps and directions for future research. *Neuroscience & Biobehavioral Reviews, 88*, 117-140. Doi: 10.1016/j.neubiorev.2018.03.015

Posner MI (1994). Attention: the mechanisms of consciousness. *Proceedings of the National Academy of Sciences of the United States of America, 91*(16), 7398-7403.

Power MJ, Dalgleish T, Claudio V, Tata P, & Kentish J (2000). The directed forgetting task: application to emotionally valent material. *Journal of Affective Disorders, 57*(1-3), 147-157. Doi: 10.1016/S0165-0327(99)00084-1

Qi S, Chen J, Hitchman G, Zeng Q, Ding C, Li H, & Hu W (2014). Reduced representations capacity in visual working memory in trait anxiety. *Biological Psychology, 103*, 92-99. Doi: 10.1016/j.biopsycho.2014.08.010

Quaglia JT, Brown KW, Lindsay EK, Creswell JD, & Goodman RJ (2015). From conceptualization to operationalization of mindfulness. In KW Brown, JD Creswell, & RM Ryan (Eds.) *Handbook of mindfulness: Theory, research, and practice* (pp. 151-170). New York: The Guilford Press.

Rapee RM (1993). The utilisation of working memory by worry. *Behaviour Research and Therapy, 31*, 617-620. Doi: 10.1016/0005-7967(93)90114-A

Rapee RM & Heimberg RG (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy, 35*, 741-756. Doi: 10.1016/S0005-7967(97)00022-3

Raye CL, Johnson MK, Mitchell KJ, Reeder JA, & Greene EJ (2002). Neuroimaging a Single Thought: Dorsolateral PFC Activity Associated with Refreshing Just-Activated Information. *NeuroImage, 15*, 447-453. Doi: 10.1006/nimg.2001.0983

Renna ME, Seeley SH, Heimberg RG, Etkin A, Fresco DM, & Mennin DS (2018). Increased Attention Regulation from Emotion Regulation Therapy for Generalized Anxiety Disorder. *Cognitive Therapy and Research, 42*, 121-134. Doi: 10.1007/s10608-017-9872-7

Robinson OJ, Pike AC, Cornwell B, & Grillon C (2019). The translational neural circuitry of anxiety. *Journal of Neurology, Neurosurgery & Psychiatry*, *90*, 1353-1360. Doi: 10.1136/jnnp-2019-321400

Roediger HL & Karpicke JD (2006). Test-Enhanced Learning: Taking Memory Tests Improves Long-Term Retention. *Psychological Science, 17*, 249-255. Doi: 10.1111/j.1467-9280.2006.01693.x

Saarimäki H, Gotsopoulos A, Jääskeläinen IP, Lampinen J, Vuilleumier P, Hari R, Sams M, & Nummenmaa L (2016). Discrete Neural Signatures of Basic Emotions. *Cerebral Cortex, 26*, 2563-2573. Doi: 10.1093/cercor/bhv086

Sari BA, Koster EHW, & Derakshan N (2017). The effects of active worrying on working memory capacity. *Cognition and Emotion, 31*, 995-1003. Doi: 10.1080/02699931.2016.1170668

Sari BA, Koster EHW, Pourtois G, & Derakshan N (2016). Training working memory to improve attentional control in anxiety: A proof-of-principle study using behavioral and electrophysiological measures. *Biological Psychology, 121*, 203-212. Doi: 10.1016/j.biopsycho.2015.09.008

Sato H, Dresler T, Haeussinger FB, Fallgatter AJ, & Ehlis AC (2014). Replication of the correlation between natural mood states and working memory-related prefrontal activity measured by near-infrared spectroscopy in a German sample. *Frontiers in Human Neuroscience, 8*. Doi: 10.3389/fnhum.2014.00037

Satpute AB & Lindquist KA (2019). The Default Mode Network's Role in Discrete Emotion. *Trends in Cognitive Sciences, 23,* 851-864. Doi: 10.1016/j.tics.2019.07.003

Scherer KR & Wallbott HG (1994). Evidence for universality and cultural variation of differential emotion response patterning. *Journal of Personality and Social Psychology, 66*, 310-328. Doi: 10.1037/0022-3514.66.2.310

Schmeichel BJ & Tang D (2015). Individual Differences in Executive Functioning and Their Relationship to Emotional Processes and Responses. *Current Directions in Psychological Science, 24*, 93-98. Doi: 10.1177/0963721414555178

Schmeichel BJ, Volokhov RN, & Demaree HA (2008). Working memory capacity and the self-regulation of emotional expression and experience. *Journal of Personality and Social Psychology, 95*, 1526-1540. Doi: 10.1037/a0013345

Schultz LT & Heimberg RG (2008). Attentional focus in social anxiety disorder: Potential for interactive processes. *Clinical Psychology Review, 28*, 1206-1221. Doi: 10.1016/j.cpr.2008.04.003

Schweizer S, Grahn J, Hampshire A, Mobbs D, & Dalgleish T (2013). Training the Emotional Brain: Improving Affective Control through Emotional Working Memory Training. *Journal of Neuroscience, 33*(12), 5301-5311. Doi: 10.1523/JNEUROSCI.2593-12.2013

Shapiro SL, Carlson LE, Astin JA, & Freedman B (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology, 62*, 373-386. Doi: 10.1002/jclp.20237

Sharp PB, Miller GA, & Heller W (2015). Transdiagnostic dimensions of anxiety: Neural mechanisms, executive functions, and new directions. *International Journal of Psychophysiology, 98*, 365-377. Doi: 10.1016/j.ijpsycho.2015.07.001

Shear MK (2012). Getting straight about grief. *Depression and Anxiety, 29*, 461-464. Doi: 10.1002/da.21963

Sheline YI, Barch DM, Price JL, Rundle MM, Vaishnavi SN, Snyder AZ, Mintun MA, Wang S, Coalson RS, & Raichle ME (2009). The default mode network and self-referential processes in depression. *Proceedings of the National Academy of Sciences of the United States of America, 106*, 1942-1947. Doi: 10.1073/pnas.0812686106

Shi R, Sharpe L, & Abbott M (2019). A meta-analysis of the relationship between anxiety and attentional control. *Clinical Psychology Review, 72*, 101754. Doi: 10.1016/j.cpr.2019.101754

Siemer M (2005). Mood-congruent cognitions constitute mood experience. *Emotion, 5*, 296-308. Doi: 10.1037/1528-3542.5.3.296

Simpson JR, Drevets WC, Snyder AZ, Gusnard DA, & Raichle ME (2001). Emotion-induced changes in human medial prefrontal cortex: II. During anticipatory anxiety. *Proceedings of the National Academy of Sciences of the United States of America, 98*, 688-693.

Smallwood J, Tipper C, Brown K, Baird B, Engen H, Michaels JR, Grafton S, & Schooler JW (2013). Escaping the here and now: Evidence for a role of the default mode network in perceptually decoupled thought. *NeuroImage, 69,* 120-125. Doi: 10.1016/j.neuroimage.2012.12.012

Smith E & Jonides J (1999). Storage and Executive Processes in the Frontal Lobes. *Science, 283*(5408), 1657-1661. Doi: 10.1126/science.283.5408.1657

Smith R, Lane RD, Alkozei A, Bao J, Smith C, Sanova A, Nettles M, & Killgore WDS. (2018). The role of medial prefrontal cortex in the working memory maintenance of one's own emotional responses. *Scientific Reports, 8*, Article 1. Doi: 10.1038/s41598-018-21896-8

Souza AS, Rerko L, & Oberauer K (2015). Refreshing memory traces: thinking of an item improves retrieval from visual working memory: Refreshing working memory traces. *Annals of the New York Academy of Sciences, 1339*, 20-31. Doi: 10.1111/nyas.12603

Spurr JM & Stopa L (2002). Self-focused attention in social phobia and social anxiety. *Clinical Psychology Review, 22*, 947-975. Doi: 10.1016/S0272-7358(02)00107-1

Stedron JM, Sahni SD, & Munakata Y (2005). Common Mechanisms for Working Memory and Attention: The Case of Perseveration with Visible Solutions. *Journal of Cognitive Neuroscience, 17*, 623-631. Doi: 10.1162/0898929053467622

Stefanopoulou E, Hirsch CR, Hayes S, Adlam A, & Coker S (2014). Are attentional control resources reduced by worry in generalized anxiety disorder? *Journal of Abnormal Psychology, 123*, 330-335. Doi: 10.1037/a0036343

Steimer, T. (2002). The biology of fear- and anxiety-related behaviors. *Dialogues in Clinical Neuroscience, 4*, 231-249. Doi: 10.31887/DCNS.2002.4.3/tsteimer

Teasdale JD (1999). Metacognition, mindfulness and the modification of mood disorders. *Clinical Psychology & Psychotherapy, 6*, 146-155. Doi: 10.1002/(SICI)1099-0879(199905)6:2<146::AID-CPP195>3.0.CO;2-E

Tettamanti M, Rognoni E, Cafiero R, Costa T, Galati D, & Perani D (2012). Distinct pathways of neural coupling for different basic emotions. *NeuroImage, 59*, 1804-1817. Doi: 10.1016/j.neuroimage.2011.08.018

Theeuwes J (2019). Goal-driven, stimulus-driven, and history-driven selection. *Current Opinion in Psychology, 29*, 97-101. Doi: 10.1016/j.copsyc.2018.12.024

Touroutoglou A Lindquist KA, Dickerson BC, & Barrett LF (2015). Intrinsic connectivity in the human brain does not reveal networks for 'basic' emotions. *Social Cognitive and Affective Neuroscience, 10*(9), 1257-1265. Doi: 10.1093/scan/nsv013

Van Dillen LF, Heslenfeld DJ, & Koole SL (2009). Tuning down the emotional brain: An fMRI study of the effects of cognitive load on the processing of affective images. *NeuroImage, 45*, 1212-1219. Doi: 10.1016/j.neuroimage.2009.01.016

Van Dillen LF & Kool SL (2007). Clearing the mind: A working memory model of distraction from negative mood. *Emotion, 7*, 715-723. Doi: 10.1037/1528-3542.7.4.715

van Ede F & Nobre AC (2021). Toward a neurobiology of internal selective attention. *Trends in Neurosciences, 44*, 513-515. Doi: 10.1016/j.tins.2021.04.010

van Schie K & Anderson MC (2017). Successfully controlling intrusive memories is harder when control must be sustained. *Memory, 25*, 9, 1201-1216. Doi: 10.1080/09658211.2017.1282518

Verduyn P, Delaveau P, Rotgé JY, Fossati P, & Van Mechelen I (2015). Determinants of Emotion Duration and Underlying Psychological and Neural Mechanisms. *Emotion Review, 7*, 330-335. Doi: 10.1177/1754073915590618

Verduyn P, Delvaux E, Van Coillie H, Tuerlinckx F, & Van Mechelen I (2009). Predicting the duration of emotional experience: Two experience sampling studies. *Emotion, 9*, 83-91. Doi: 10.1037/a0014610

Verduyn P & Lavrijsen S (2015). Which emotions last longest and why: The role of event importance and rumination. *Motivation and Emotion, 39*, 119-127. Doi: 10.1007/s11031-014-9445-y

Vytal K, Cornwell B, Arkin N, & Grillon C (2012). Describing the interplay between anxiety and cognition: From impaired performance under low cognitive load to reduced anxiety under high load: Anxiety and cognition. *Psychophysiology, 49*, 842-852. Doi: 10.1111/j.1469-8986.2012.01358.x

Vytal K, Cornwell BR, Letkiewicz AM, Arkin NE, & Grillon C (2013). The complex interaction between anxiety and cognition: insight from spatial and verbal working memory. *Frontiers in Human Neuroscience, 7*. Doi: 10.3389/fnhum.2013.00093

Wager TD, Davidson ML, Hughes BL, Lindquist MA, & Ochsner KN (2008). Prefrontal-Subcortical Pathways Mediating Successful Emotion Regulation. *Neuron, 59*, 1037-1050. Doi: 10.1016/j.neuron.2008.09.006

Wallace BA (2001). Intersubjectivity in Indo-Tibetan Buddhism. *Journal of Consciousness Studies, 8*, 209-230.

Wanmaker S, Geraerts E, & Franken IHA (2015). A working memory training to decrease rumination in depressed and anxious individuals: A double-blind randomized controlled trial. *Journal of Affective Disorders, 175*, 310-319. Doi: 10.1016/j.jad.2014.12.027

Wells A (2011). *Metacognitive Therapy for Anxiety and Depression*. New York: The Guilford Press.

Wenzlaff RM & Wegner DM (2000). Thought suppression. *Annual Review of Psychology, 51*, 59-91. Doi: 10.1146/annurev.psych.51.1.59

Wilhelm O, Hildebrandt A, & Oberauer K (2013). What is working memory capacity, and how can we measure it? *Frontiers in Psychology, 4*, 433. Doi: 10.3389/fpsyg.2013.00433

Woody SR & Rodriguez BF (2000). Self-Focused Attention and Social Anxiety in Social Phobics and Normal Controls. *Cognitive Therapy and Research, 24*, 473-488. Doi: 10.1023/A:1005583820758

Xiu L, Wu J, Chang L, & Zhou R (2018). Working Memory Training Improves Emotion Regulation Ability. *Scientific Reports, 8*, Article 1. Doi: 10.1038/s41598-018-31495-2

Yaroslavsky I, Allard ES, & Sánchez-López A (2019). Can't look Away: Attention control deficits predict Rumination, depression symptoms and depressive affect in daily Life. *Journal of Affective Disorders, 245,* 1061-1069. Doi: 10.1016/j.jad.2018.11.036

Young KS, Sandman CF, & Craske MG (2019). Positive and Negative Emotion Regulation in Adolescence: Links to Anxiety and Depression. *Brain Sciences, 9*, 76. Doi: 10.3390/brainsci9040076

Young S (2016). *The Science of Enlightenment: How Meditation Works*. Louisville, CO: Sounds True.

Zabelina DL, Clay JZ, & Upshaw JD (2021). The Association between Imagination and Anxiety in the Times of the COVID-19 Pandemic. *Creativity Research Journal, 33,* 264-274. Doi: 10.1080/10400419.2020.1871549

Zanarini MC, Weingeroff JL, & Frankenburg FR. (2009). Defense Mechanisms Associated with Borderline Personality Disorder. *Journal of Personality Disorders, 23*, 113-121. Doi: 10.1521/pedi.2009.23.2.113

Zelazo PD & Cunningham WA (2007). Executive Function: Mechanisms Underlying Emotion Regulation. In JJ Gross (Ed.), *Handbook of emotion regulation* (pp. 135-158). New York: The Guilford Press.

Zhou Y, Curtis CE, Sreenivasan KK, & Fougnie D (2022). Common Neural Mechanisms Control Attention and Working Memory. *The Journal of Neuroscience, 42*(37), 7110-7120. Doi: 10.1523/JNEUROSCI.0443-22.2022

Zou JB, Hudson JL, & Rapee RM (2007). The effect of attentional focus on social anxiety. *Behaviour Research and Therapy, 45*, 2326-2333. Doi: 10.1016/j.brat.2007.03.014

Final Acceptance, May 9, 2023