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Cognitive Biases in Perfectionism: Attention Bias and Memory Bias for Perfectionism-Relevant and Negative Stimuli

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COGNITIVE BIASES IN PERFECTIONISM: ATTENTION BIAS AND MEMORY BIAS FOR PERFECTIONISM-RELEVANT AND NEGATIVE STIMULI

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77 Pages

Research suggests there are biases that affect cognitive processes such as attention and memory in affective disorders (Everaert et al., 2020; Grant et al., 2020) and traits associated with these disorders, such as perfectionism (Besser et al., 2008; Howell et al., 2016; Tonta et al., 2019). However, very limited research exists on the relationship between attention and memory bias in perfectionism. The aim of the current study was to examine to what extent cognitive biases exist and how they are related in perfectionism. I combined a dot probe task to measure attention bias with a recognition task to measure memory bias using perfectionism-relevant, negative, positive, and neutral stimuli. The results suggest attention bias does not mediate the relationship between perfectionism and memory bias, regardless of word type. However, results showed perfectionism was directly related to memory bias for perfectionism-relevant words only. Perfectionism was positively correlated with hits for perfectionism-relevant and negative words, not positive or neutral words, suggesting perfectionism does have a role in memory bias. Limitations, future directions, and implications are discussed. To my knowledge this was the first study that examined both attention bias and memory bias in perfectionism. Understanding the relationship between cognitive biases in perfectionism can help improve mental health as perfectionism has become more prevalent and increasingly linked to mental health issues.

KEYWORDS: perfectionism; attention bias; memory bias; emotion

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E.M.M.

CONTENTS

TABLES

FIGURES

CHAPTER I: INTRODUCTION

Cognitive biases are "systematic errors in thinking" that occur during information processing and interpretation, and they can affect decision making (Grant et al., 2020, p.180). Additionally, cognitive biases are systematic and frequent deviations from normal processing (Caverni et al., 1990). Research has shown that cognitive biases can affect a range of processes including attention, perception, interpretation, and memory. Cognitive biases have been established as both a symptom of and a cause of emotional disorders (Everaert et al., 2020; Grant et al., 2020). In cognitive theories of disorders there is evidence of automatic negative biases in cognitive processes of attention, interpretation, and memory (Mathews & MacLeod, 2005). Research suggests these biases do not operate in isolation (Blaut et al., 2013; Daches et al., 2019; Everaert et al., 2012, 2013, 2014, 2018, 2020; Hirsch et al., 2006; Koster et al., 2010; Wittenborn et al., 2016). Despite evidence of the interaction of cognitive biases, the majority of research investigates these biases individually.

Research has focused on negative biases in cognitive processes, or the systematic prioritization of negative information. These biases towards negative information are often associated with poor mental health outcomes and considered a deviation from normal processing since healthy individuals tend to allocate more attention to and show better memory for positive stimuli (Gotlib & Joormann, 2010). Emotional factors can influence these biases and distort cognition and decision making (Grant et al., 2020).

A bias for prioritizing and processing negative information has been found in perfectionists (Besser et al., 2008; Howell et al., 2016; Tonta et al., 2019). There is a cognitive basis for perfectionism (Flett et al., 2018; Shafran et al., 2002), and research suggests there are biases in the cognitive processes of attention (Howell et al., 2016; Tonta et al., 2019) and

memory (Besser et al., 2008) as well. Similar to cognitive biases in anxiety where threat related cues are prioritized, threat related cues are prioritized in perfectionism; however, these cues signal threats to perfectionistic beliefs or ideals, such as the possibility of failure, mistakes, and negative evaluations (Flett et al., 2018). Research suggests cognitive biases are interdependent, however very limited research exists on the relationship between attention and memory bias in perfectionism. The purpose of the current study was to examine the existence of and relationship between attentional bias and memory bias for perfectionism-relevant and negatively valenced emotional stimuli in perfectionism.

CHAPTER II: REVIEW OF THE LITERATURE

Perfectionism

Research has looked at perfectionism in a variety of ways including as a trait, unidimensional, multidimensional, or transdiagnostic construct. Across all these views researchers generally agree perfectionism can be defined as a personality trait characterized by the setting of exceptionally high standards for performance, overly critical self-evaluations (Frost et al., 1990), and a striving for flawlessness (Flett & Hewitt, 2002). Perfectionists tend to rigidly adhere to these unrealistic standards, have biased interpretations of events, and define themselves by their ability to achieve their goals (Burns, 1980).

Perfectionism can be adaptative or maladaptive. Early research by Hamachek (1978) distinguished between two types of perfectionism—normal and neurotic. *Normal perfectionists* set and aim for high standards but can feel accomplished even if those are not met and allow for mistakes (Hamachek, 1978). *Neurotic perfectionists* set unattainable high standards, don't allow for mistakes, and are constantly concerned with perfection and failure (Hamachek, 1978). Similarly, Slade and Owens (1998) proposed a Dual Process Model of Perfectionism which distinguished between positive and negative perfectionists. *Positive perfectionists* pursue perfection due to the positive reinforcement of successful outcomes, whereas *negative perfectionists* pursue perfection to avoid negative consequences of failure or due to negative reinforcement (Slade & Owens, 1998). Slade and Owens (1998) further the distinction by suggesting positive perfectionists set realistic standards and are satisfied when they achieve success, whereas negative perfectionists set unrealistic standards and can't be satisfied due to their preoccupation with fear of failure in the future.

Research has built on these distinctions in terms of adaptative and maladaptive perfectionism. *Adaptive perfectionism* includes high standards, and *maladaptive perfectionism* includes discrepancy, or feelings of falling short of high standards (Slaney et al., 2002). Research by Richardson and colleagues (2014) supports the distinction of these two types of perfectionism and suggests adaptive perfectionists primarily use reappraisal as an emotion regulation strategy, whereas maladaptive perfectionists primarily use suppression. However, recent research has cautioned against the use of value-laden labels of perfectionism, adaptive and maladaptive, and suggests neutral labels to define perfectionism. It is argued that value-laden labels artificially increase the likelihood of outcomes associated with the value label (Gaudreau, 2019).

Another way research conceptualizes perfectionism is as a two-dimensional construct of perfectionistic strivings and perfectionistic concerns (Lo & Abbott, 2013). *Perfectionistic strivings* are characterized by the setting of high personal standards (Lo & Abbott, 2013) and are considered adaptive (Stoeber & Otto, 2006). Perfectionistic strivings are positively related to life satisfaction and positive mood (Hill et al., 2010). *Perfectionistic concerns* are characterized by overly worrying about making mistakes, feelings of discrepancy (Lo & Abbott, 2013; Sherry et al., 2016), and the evaluation of one's self against these standards (Limburg et al., 2017). Perfectionistic concerns are considered to be maladaptive (Limburg et al., 2017) and are associated with increased depression, anxiety, worry, and stress (Smith et al., 2014).

With respect to psychopathology, perfectionism has been considered to be a transdiagnostic construct. Perfectionism has been demonstrated to be both a risk factor and a maintaining factor for a range of disorders (Egan et al., 2011; Flett & Hewitt, 2002). Research has linked perfectionism to multiple poor health outcomes (Molnar et al., 2018). Specifically, maladaptive perfectionism has been shown to be a factor in eating disorders, anxiety disorders,

obsessive-compulsive disorders, and mood disorders such as depression (Egan et al., 2011; Howell et al., 2016).

Perfectionism and Cognition

Flett et al. (1998) proposed the idea that personality traits involved in depression and anxiety, such as perfectionism, have a cognitive component that contribute to distress and should be addressed. Perfectionistic cognitions include automatic thoughts, rumination, and information processing that are centered around the discrepancy between high standards and performance, fear of failure, mistakes, and the need to be perfect. Flett et al. (1998) found that frequent perfectionistic cognitions (automatic thoughts, rumination) were associated with higher levels of psychological distress (depression, anxiety), general negative affectivity, and life dissatisfaction. Flett et al. (1998) suggested the tendency to engage in perfectionistic thinking could promote cognitive biases and increase the likelihood of using strict criteria for self-evaluations. Flett and colleagues' (2002) results further support the idea that frequent perfectionistic cognitions and related forms of rumination contributed to psychological distress.

One of the first models of perfectionism to consider cognition was the Cognitive-Behavioral Model of Clinical Perfectionism proposed by Shafran et al. (2002). They proposed that perfectionists had processing biases that inevitably lead to a negative self-evaluation (Shafran et al., 2002) and feeling as though they are less of a person because of failures (Burns, 1980; Frost et al., 1990). Prior research supported their claims for biases including dichotomous thinking (Egan et al., 2007), selective attention, and overgeneralization (Anthony & Swinson, 1998). The Cognitive-Behavioral Model suggests perfectionists' self-evaluations will result in a negative outcome after both failures and success because perfectionists have a dysfunctional schema for self-evaluations that is overly dependent on striving for and achieving high standards

(Shafran et al., 2002). Immediately following success, perfectionists reappraise their standards as having previously been too low, discount their success, and set increasingly higher standards (Shafran et al., 2002). This reappraisal makes it more likely they will experience failure and maintain their cycle of negative evaluations (Shafran et al., 2002). Shafran and colleagues also made a clear distinction to identify when perfectionism becomes dysfunctional and pathological. They argued that failure to meet high standards results in cognitive, emotional, behavioral, social, or physical consequences. When perfectionists' self-evaluation is so dependent on success that they continue to pursue their high standards despite these consequences, it has become dysfunctional (Shafran et al., 2002).

Another major development in perfectionism and cognition research is the Perfectionism Cognition Theory's recent extended framework (Flett et al., 2018). The Perfectionism Cognition Theory (PCT) provides a theoretical account of the cognitive mechanism of perfectionism. There are three central tenants of the theory: (a) perfectionism is associated with faster, more frequent, and prolonged rumination; (b) perfectionists are prone to experience various types of overthinking; and (c) excessive cognitive activation leads to overdeveloped memory for mistakes and failures (Flett et al., 2018). PCT also suggests these tenants are supplemented with hypervigilance and cognitive bias towards cues that signal the possibility of failure, mistakes, and negative evaluations (Flett, et al., 2018).

The expanded framework of PCT used the cognitive taxonomy proposed by Ingram (Ingram, 1990a; Ingram & Kendall, 1986; Ingram, Miranda, & Segal, 1998) that included four levels: structural, propositional, operational, and cognitive products. The *structural level* of PCT includes cognitive structures, such as the core schemas about the self, ideal self, and episodic memories of success and failure (Flett et al., 2018). The *propositional level* includes

dysfunctional beliefs that are centralized to reflect a person's sense of self focused on the theme of perfection (Flett et al., 2018). The *operational level* includes active cognitive operations, such as negative, internal thoughts that occupy attention and reduce cognitive capacity (Flett et al., 2018). At the operational level, PCT suggests perfectionists will have an attentional bias toward cues that connote failure (supported by Howell et al., 2016), perfectionists will have a bias for perfectionism-relevant cues especially in a negative mood state (supported by Besser et al., 2008), and these biases will act as cognitive interference that limits the capacity of working memory (supported by Ben-Artzi & Raveh, 2016). The last level, *cognitive products*, includes cognitions such as automatic and ruminative thoughts (Flett et al., 2018). Cognitive products, such as frequent, uncontrollable images or thoughts about perfection, reduce cognitive resources (Flett et al., 2018). Research has shown evidence of these automatic and intrusive cognitions following stressful events (Flett et al., 1998, 2002) and increased fear-of-failure beliefs in perfectionists (Conroy et al., 2007). The theory also proposes the concept of perfectionistic reactivity in which less-than-optimal responses and reactions occur when life outcomes suggests things are far from perfect; these responses can be cognitive, emotional, behavioral, social, or motivational (Flett et al., 2018). A recent meta-analysis examined PCT themes and found correlations between perfectionism, worry, rumination, and cognitive perseveration (Xie et al., 2019).

There is a substantial amount of research that supports the cognitive aspect of perfectionism. Multiple dimensions of perfectionism are significantly related to irrational cognitions (Flett et al., 1991a; Flett et al., 1998), and these perfectionistic cognitions are associated with psychological distress (Flett et al., 1998; Flett et al., 2007; Flett et al., 2002). Studies also demonstrate that individuals high in perfectionistic cognitions are more likely to

experience negative affect (Flett et al., 2007) which mimics Beck's (1976) cognitive model that emphasized the role of negative automatic thoughts in emotional distress. Perfectionistic cognitions account for significant unique variance in distress (Casale et al., 2020) and are associated with emotion regulation, anxiety, and depression measures in nonclinical samples (Tyler et al., 2020). Additional research supports the link between perfectionistic cognitions, negative automatic thoughts, and psychological distress (Pirbaglou et al., 2013) and deficits in cognitive emotion regulation (Rudolph et al., 2007). Rudolph and colleagues (2007) found that frequent perfectionistic cognitions were associated with maladaptive cognitive emotion regulation strategies, including catastrophization, rumination, lack of positive reappraisal, and self-blame. Gellatly and Beck (2016) identified catastrophic thinking as the tendency to see negative outcomes as horrible catastrophes; this tendency contributes to various forms of emotional distress. Flett et al. (2018) reported that perfectionistic worriers were prone to multiple forms of catastrophic thinking. Maladaptive cognitions, catastrophizing, and rumination have been shown to be mediators between perfectionistic concerns and depression and anxiety (Macedo et al., 2017).

Much of the research on cognitive aspects of perfectionism has been based on the Perfectionism Cognitions Inventory (PCI; Flett et al., 1998). The PCI is a 25-item measure that assesses the frequency of thoughts involving themes of perfectionisms (Flett et al., 1998). Research shows that PCI scores are relatively stable over time and suggests perfectionistic thoughts are persistently activated and are therefore high in cognitive availability and accessibility (Besser et al., 2008). There is evidence supporting perfectionistic cognitions' role in a variety of factors; PCI scores account for a significant degree of variance in psychological distress (Flett et al., 1998), depression (Flett et al., 2012), burnout (Hill & Appleton, 2011),

deficits in cognitive self-control (Flett et al., 2007), and eating disorders (Flett et al., 2011), beyond variance attributable to trait perfectionism (Flett et al., 2011). One key aspect of cognitive theories of perfectionism is the concept of biased cognitive processing, including attention biases.

Attention Bias

Attentional processes are "essential for selecting and evaluating significant information to be further processed" (Luecken et al., 2004, p. 23). Attention bias can be defined as a systematic preference to allocate attention towards specific types of stimuli (Bar-Haim et al., 2007; Howell et al., 2016). Attention biases in psychological disorders have been researched in reference to threat stimuli, or other emotionally charged stimuli, and compared to neutral stimuli. Allotting attention to or away from threat cues controls the amount of threatening information processed and can regulate arousal (Hock, 1993). Attention biases towards threat cues have been found in individuals experiencing psychological distress (MacLeod & Mathews, 1988; Mogg et al., 1995), and sustained attention to negative information has been associated with the cognitive symptoms of depression (Baert et al., 2020). Research has demonstrated the ability to decrease positive attentional biases through negative mood inductions and rumination (Morrison & O'Connor, 2008). Rumination has also been associated with an attentional bias towards loss and failure (Hur et al., 2019).

Research distinguishes between types of attention biases, such as engagement or disengagement biases. An *engagement bias* is characterized by attention that's quickly caught by the stimuli, whereas a *disengagement bias* is characterized by a greater difficulty to disengage attention from stimuli (Cisler & Koster, 2010; Tonta et al., 2019). Engagement biases have been linked to anxiety and increased awareness (Koster et al., 2006). It's been suggested that

disengagement biases represent the continued processing of threat stimuli and are linked to the maintenance of anxiety (Koster et al., 2006). Research has consistently shown that successful modification of attentional biases for threat stimuli is associated with positive emotional effects for multiple forms of psychological distress (Clarke et al., 2014; MacLeod & Clarke, 2015).

There are two common ways to measure attention biases. A modified version of the Stroop task (Stroop, 1935), referred to as the emotional Stroop task, has been one method used to study attention bias. During the emotional Stroop task, participants color-name neutral words, threat words, or different emotionally valanced words. Response times are recorded, and delays in color-naming to specific categories of words are believed to be caused by cognitive interference and considered evidence of an attentional bias. There are limitations of the Stroop task as a measure of attention, however. Specifically, it is hard to determine if response delays are due to attentional vigilance or cognitive avoidance (Mogg et al., 2000).

Currently, the most widely used and accepted measure of attention biases is the dot probe task (MacLeod et al., 1986). The dot probe task has participants view a neutral and threatening word pair, or different emotionally valanced word pairs, on opposite sides of the screen. The words appear briefly, and when they disappear one of the words is replaced by a black dot on the screen. Participants then identify which side of the screen the dot is on. Attentional bias is measured by the response time to neutral and target (emotional or threat) words. An attentional bias towards target word is demonstrated when participants' response time is faster when the dot replaces the target word as compared to the neutral word. Slower response times when the dot replaces the neutral word indicates a difficulty disengaging from the target word. This suggests the participant's attention was on the spatial location of the threat word. The dot probe task is

advantageous in that it can be used to differentiate between engagement and disengagement biases (Tonta et al., 2019).

Perfectionism and Attention Bias

Research on the cognitive aspects of perfectionism include the idea of an attentional bias that allocates significantly more attention and processing to negative information than to positive information (Flett et al., 2018; Shafran et al., 2002). This attentional bias increases the processing of negative stimuli and prioritizes it over positive stimuli which leads to cognitive distortions such as discounting success and overgeneralizing failure (Egan et al., 2011; Shafran et al., 2002; Shafran et al., 2010). Prior attention bias research has focused on threat cues, which for perfectionists can include threats to perfection, such as cues that connote failures, mistakes, and negative evaluations (Flett, et al., 2018). Hollender (1965) observed that a perfectionist with this bias is "constantly on the alert for what is wrong and seldom focuses on what is right" (p. 95). Attention biases are already incorporated into cognitive-behavioral therapies (CBT) for perfectionism. Part of CBT is to evaluate and adjust patterns of selective attention (Egan et al., 2014). However, little experimental research has been done on the role of attention biases in perfectionism.

Research that has been done on attention biases in perfectionism shows that perfectionists have an attentional bias towards negative stimuli (Howell et al., 2016; Kobori & Tanno, 2012; Tonta et al., 2019). Kobori and Tanno's (2012) study on perfectionism and selective attention focused on self-oriented perfectionism, using the Hewitt and Flett Multidimensional Perfectionism Scale (Hewitt & Flett, 1991), and an emotional Stroop task. Participants included 40 Japanese college students that scored either high or low in self-oriented perfectionism. The emotional Stroop task contained 8 words associated with failure and 8 neutral words. Results

showed that participants who scored highly on self-oriented perfectionism had longer reaction times for failure words than participants with low scores on self-oriented perfectionism. The findings support the idea of a cognitive basis for perfectionism. However, there are several limitations of this study. First, the sample size was small and only looked at Japanese college students which makes it difficult to generalize the findings. Second, the emotional Stroop task cannot determine if attention biases are the only cause of delayed response times (Bar-Haim et al., 2007). Third, Kobori and Tanno (2012) only used negative words related to perfectionism. These words ignore the potential adaptive aspects of perfectionism, and the extent of the negative attention bias cannot be evaluated.

Howell et al.'s (2016) study was the first to experimentally test Shafran et al.'s (2002) proposal that perfectionists have a bias that allocates greater attention to negative information than to positive information that is perfectionism relevant. Participants included 25 low-scoring perfectionists and 31 high-scoring perfectionists according to the *concern over mistakes* subscale of the Frost Multidimensional Perfectionism Scale (Frost et al., 1990). To address limitations of the emotional Stroop task used in prior research, an attention probe (dot probe) task was used in the study. The word list included 16 words in each of four categories: (a) negatively valanced and perfectionist-irrelevant (e.g., *attack*), (b) negatively valanced and perfectionist-relevant (e.g., *failure*), (c) positively valanced and perfectionist-irrelevant (e.g., *fearless*), and (d) positively valanced and perfectionist-relevant (e.g., *success*). The attention probe task was used to compare attentional responding to the different categories of words. Results showed that high perfectionists allocated significantly more attention to negative information than positive information, but only when it was perfectionism-relevant. Howell et al. (2016) suggested that because negative perfectionism-relevant stimuli are words that concern performance, evaluation,

standards, or failure, these words are prioritized as they could act as threat cues. Whereas positive perfectionism-relevant stimuli include words that connote success and praise, these words do not pose a threat to perfection, and thus, are less likely to receive attention or be discounted (Howell et al., 2016). One limitation of this study is that it did not evaluate the type—engagement or disengagement—of attention bias.

Tonta et al. (2019) examined—for the first time—the relationship between perfectionistic strivings and concerns with threat-related attention biases. They also attempted to distinguish between an engagement and disengagement bias. Prior attention bias research has focused on the maladaptive aspects of perfectionism despite the links between perfectionistic strivings and distress (Limburg et al., 2017). Tonta et al.'s study included 104 participants that completed the Frost Multidimensional Perfectionism Scale Brief (Burges et al., 2016) to assess perfectionistic strivings and perfectionistic concerns, and they completed a modified dot probe task to assess attention. The researchers used the word lists validated by Howell et al. (2016) to create five categories of words for the dot probe task: (a) neutral (e.g., *sock*), (b) positively valanced and perfectionism-relevant (e.g., *achievement*), (c) positively valanced and perfectionism-irrelevant (e.g., *kind*), (d) negatively valanced and perfectionism-relevant (e.g., *unsuccessful*), and (e) negatively valanced and perfectionism-irrelevant (e.g., *attack*). An attention-bias index score was calculated based on the average reaction time in each of the five conditions. Results showed that individuals with high levels of perfectionistic concerns had a disengagement bias for negative information, regardless of whether it was perfectionism-relevant or irrelevant. This means individuals high in perfectionistic concerns have significantly more difficulty disengaging or removing their attention from emotionally negative stimuli (Tonta et al., 2019). A similar study conducted by Tsubota and Ishii (2019) found that in men, the *concerns over mistakes* subscale of

perfectionism was positively correlated with an engagement bias to failure related words, meaning that failure words captured perfectionists' attention more rapidly than the success-related words.

Memory Bias

A *memory bias* can be defined as a cognitive bias that enhances or impairs memory. An *emotion memory bias* is the "tendency to selectively recall emotional or mood-congruent memories" (Grant et al., 2020, p. 173). A *negative memory bias* or a memory bias for negative information is where negative information is recalled more accurately and more frequently than positive or neutral information (Gotlib & Joormann, 2010). Furthermore, this preferential processing of negative stimuli can be involuntary (Gotlib & Joormann, 2010).

Bower (1981) proposed one of the first theories of memory bias in psychiatric disorders. The theory was based on previous models of associative and semantic networks. Bower suggested mood congruent memory biases could be explained through semantic networks. Emotions, concepts, and events are nodes within semantic networks, and the activation of one node spreads to activate additional nodes associated with related emotions (Bower, 1981). Furthermore, when affective state during retrieval is congruent with information being recalled it is more easily retrieved (Bower, 1981). Bower also suggested that negative memory bias occurs due to the implicit priming of these conceptual nodes associated with negative emotions. Bower furthered specified that, in depression, the cues needed to activate negative nodes are more generalized; therefore, the negative emotions are more likely to be prompted. Memory bias research has shown support for Bower's mood congruent memory biases, where an individual is more likely to recall information that conceptually matches their mood (Watkins, 2002).

Another theory of cognitive biases in psychiatric disorders comes from Beck et al. (1985) and is widely considered to be one of the most influential. Beck's theory of depression includes the concept of *schemas* which are stable, cognitive structures that represent past experiences (Grant et al., 2020). Beck suggested that schemas are activated by relevant stimuli which lead to schema-congruent processing (Beck et al., 1979). Furthermore, Beck distinguished between disorder-specific schemas; depression has schemas associated with loss (Beck et al., 1979), and anxiety schemas are associated with threat (Beck et al., 1985). Beck's theory of depression describes three central schemas, also known as the negative cognitive triad: view of the self, world, and future (Beck et al., 1979). A negative view of the self includes thoughts of inadequacy, a negative view of the world includes the belief that every personal experience will result in failure, and a negative future view includes thoughts of hopelessness (Grant et al., 2020). The biased recall of negative, self-relevant information is a characteristic of (Beck et al., 1979) and is predictive of depression (Connolly et al., 2016). Research has shown that memory biases are especially present when processing self-relevant information (Benau et al., 2019) and are linked to dysfunctional cognitive schemas (Niedtfeld et al., 2020) which is a core component of Beck et al.'s (1979) theory.

A third theory developed by Williams and colleagues (1988) suggested negative cognitive biases in memory are due to elaborative encoding. *Elaboration* is the process of assigning additional meaning to the concept being encoded which assists in memorization (Grant et al., 2020). Negative cognitive biases in depression would be due to "explicit assignment of additional meaning to negative information" (Grant et al., 2020, p.177). The revised model proposed by Williams et al. (1997) had three main assumptions: (a) encoding and retrieval involve both automatic and strategic mechanisms, (b) there are distinct biases at the different

levels of memory processing, and (c) emotional states can affect information processing differently.

Research supports the existence of memory biases in multiple disorders characterized by interpersonal difficulties (Niedtfeld et al., 2020) and in maladaptive personality traits that may result in enhanced memory for negative information (Niedtfeld et al., 2020). A memory bias for negative information is representative of a depressotypic style of processing and is found in various mental disorders (Duyser et al., 2020), including anxiety (Kalenzaga & Jouhaud, 2018), eating disorders (Nikendei et al., 2008), and ADHD (Vrijsen et al., 2018b). Memory biases for negative information have been well established in depression (Mathews & MacLeod, 2005), especially in relation to negative mood, feelings of failure, pessimism, and worthlessness (Marchetti et al., 2018). Usually in psychiatric disorders a negative memory bias will be automatic and a "central mechanism in the maintenance of emotion-related pathologies" (Grant et al., 2020, p. 173). Research suggests simply the existence of negative memory biases is transdiagnostic (Grant et al., 2020).

Grant and colleagues (2020) recently laid out different research methods for examining negative biases at the different stages of memory processing: encoding, recognition, and recall. *Recognition* is the "rapid process of recognizing information as familiar and does not require deep processing" (Grant et al., 2020, p. 179), whereas *recall* is the process of retrieving details about information such as a stimulus, situation, or past event that requires deeper processing (Grant et al., 2020). Attention can be considered the first phase of memory processing since stimuli have to be attended to first in order to be encoded (Tas et al., 2016). Therefore, one way to assess encoding biases is by using attention tasks that require participants to make quick evaluations of stimuli (Grant et al., 2020). Research has found that encoding biases can predict

negative memory biases in recall tasks when the same stimuli are used in both the encoding and recall tasks (Grant et al., 2020; Hirsch et al., 2006). To assess emotional biases in recall, the number of emotionally valanced words recalled should be compared to the total number of words presented in a recall memory test (Grant et al., 2020).

Perfectionism and Memory Bias

Research on the cognitive aspects of perfectionism include the idea of negative memory bias. This bias can be explained through Perfectionism Cognition Theory by excessive cognitive activation and preservation that leads to overdeveloped memory for mistakes and failures (Flett et al., 2018). It may also be explained by the Cognitive-Behavioral Model of Clinical Perfectionism which suggests perfectionists allocate significantly more processing to negative information than to positive information (Shafran et al., 2002). Despite the widespread support of the cognitive aspects of perfectionism and the use of attention and memory modification in cognitive-behavioral therapies for perfectionism and related disorders, very little experimental research has been done on perfectionism and memory bias.

One of the only studies to experimentally investigate perfectionism and memory for positive, negative, and perfectionistic content was conducted by Besser and colleagues (2008). Participants included 314 undergraduate Israeli students randomly assigned to a positive, negative, or neutral mood-induction condition. Both the Perfectionism Cognitions Inventory (Flett et al., 1998) and the Multidimensional Perfectionism Scale (Hewitt & Flett, 1991) were used to measure perfectionism. Following successful mood inductions (via music), participants viewed a list of 80 words: 20 positively valanced words, 20 negatively valanced words, 20 neutral words, and 20 perfectionistic words. A brief distractor task was included to eliminate the recency effect. The recognition task included 40 previously studied words (10 of each type) and

40 distractor words not previously studied. Participants had to identify if the word was on the previously studied list or not. Recognition memory score was determined by the proportion of hits (correctly identified words) minus false alarms (words participants identified as being previously studied but were not actually). Results showed that perfectionists had enhanced recognition memory for negative words and perfectionism-related words, especially when in the negative mood condition. Besser et al. (2008) suggested perfectionists are cognitively predisposed to process negative information.

In another study, Ben-Artzi and Raveh (2016) investigated the relationship between adaptive and maladaptive perfectionism on false memories using the Deese-Roediger-McDermott (DRM; Roediger & McDermott, 1995) word lists paradigm. In the DRM, participants are presented with a list of words that are semantically related to a non-presented critical lure item. On a subsequent recognition test, participants are asked to identify if a word was on the presented list or if it is new. Since the DRM requires participants to make set decisions about true and false memory traces, this paradigm is thought to challenge perfectionists due to the fear of failure and concerns over mistakes (Ben-Artzi & Raveh, 2016). Participants included 97 college students who were native Hebrew speakers. Two subscales from the Almost Perfect Scale – Revised (Slaney et al., 2001) were used to assess perfectionism: high standards was used to measure perfectionistic strivings, and discrepancy was used to measure perfectionistic concerns. Participants listened to 10 DRM lists of 12 items and then completed a recognition test. The recognition test included the presentation of 50 words: 20 were previously studied words, 10 words were the critical lures for the DRM lists, and 20 words were non-studied unrelated words. When each word was presented, participants had to make two judgements: (1) presented/not presented (i.e., was the word on the studied lists) and (2) sure/not sure (i.e., how

confident they were about the first judgement). Results showed perfectionistic concerns were associated with higher levels of false memories or more inaccurate memory, whereas perfectionistic strivings were associated with more accurate memory. Ben-Artzi and Raveh (2016) suggested one explanation for this difference could be poor working memory capacity found for individuals high in perfectionistic concerns as they had a lower discriminative ability, meaning they struggled more with differentiating true and false memories than individuals low in perfectionistic concerns.

Attention and Memory

Research suggests that the cognitive processes of attention and memory are inherently connected. Some researchers go further and say, "attention and memory cannot operate without each other" (Chun & Turk-Browne, 2007, p. 1). Attention can be viewed as a limited resource that is needed for the storage and processing of information and memory maintenance (see Oberauer, 2019 for review) or as a "mechanism for selecting and prioritizing information" (Oberauer, 2019, p. 7). Research has distinguished between controlled and automatic attention. *Controlled attention* is when our attention is directed towards our current goals and we selectively attend to information that monitors outcomes (e.g., information about the success or failure of our tasks) (Oberauer, 2019), whereas *automatic attention* is when attention is directed to aspects independent of our goals (e.g., attention captured by errors or unexpected difficulties) (Oberauer, 2019). Automatic attention can be perceptual, if our attention is captured by salient stimuli or stimuli learned to be relevant. Automatic attention can also be non-perceptual, which includes involuntary retrieval from long-term memory and intrusive thoughts (Oberauer, 2019).

Other researchers argue that attention and memory are not only related but that certain aspects of memory can be considered as actions of selective attention (Long et al., 2018).

Researchers suggest that memory retrieval is a form of selective attention (Chun & Johnson, 2011; Chun & Turk-Browne, 2007) since successful retrieval requires selecting the "goal-relevant memories over competing or interfering alternatives" (Long et al., 2018, p. 287). In this line of research, different types of attention are considered to be involved in different parts of the memory process. Memory encoding processes involve the use of *perceptual attention*, whereas memory retrieval processes involve the use of *reflective attention* (Chun & Johnson, 2011). Research has shown that, due to memory's limited capacity, attention determines what gets encoded (Chun & Turk-Browne, 2007), and memory directs attention (Chun & Turk-Browne, 2007). Furthermore, when stimuli are not fully attended to, encoding is impaired (Long et al., 2018).

A series of experiments conducted by Downing (2000) support the notion that memory can guide attention. Downing showed that the contents of working memory can guide attention even when there is no explicit search task, as attention will shift to items that match working memory content (Downing, 2000). Downing suggested that working memory helps direct selective attention processes.

Attention and Memory Biases

Cognitive models for disorders have described the combined effects of cognitive biases, however very little research has examined the relationship between these biases. Instead, most of the research that supports these models examined cognitive biases individually. Hirsch and colleagues (2006) proposed the combined cognitive biases hypothesis. The combined cognitive biases hypothesis (CCBH) suggests cognitive biases, including attention, memory, and interpretation, interact and influence one another to maintain a given disorder (Everaert et al., 2012; Hirsch et al., 2006). The CCBH goes further to suggest the effects of cognitive biases have

a greater impact on perpetuating the disorder when they work in combination than when any single bias operates in isolation (Hirsch et al., 2006). Initial research found a relationship between attentional and memory bias in dysphoria (Koster et al., 2010). Results showed a negative attention bias predicted subsequent recall of negative words that had been presented in the attention task (Koster et al., 2010).

Everaert and colleagues (2012) were the first to apply the CCBH to depression research. They conducted an extensive review of prominent theoretical frameworks that account for cognitive biases in processing. The data indicated various cognitive biases in depression are associated (Everaert et al., 2012). Everaert et al. (2013) continued this line of research by examining the indirect effects of attention bias on memory through interpretation bias in depressed and non-depressed samples. Participants completed a spatial cueing task to measure attention, a scrambled sentences test (SST; Wenzlaff & Bates, 1998) to measure interpretation bias, and an incidental free recall task to measure memory bias. The spatial cueing task worked like a dot probe task and had 20 negative words (e.g., *sad*), 20 positive words (e.g., *happy*), and 20 neutral words (e.g., *central*). The same words from the spatial task were used for the interpretation and memory bias tasks. In the interpretation tasks, participants have to solve 20 scrambled sentences. Six words are displayed, and only five can be used to form a grammatically correct and meaningful sentence (e.g., *looks the future bright very dismal*). Each set of words could form either a positive (e.g., *the future looks very bright*) or negative (e.g., *the future looks very dismal*) sentence. Participants are instructed to report what first comes to mind. The memory task is a recall test that requires participants to recall the sentences they formed. The results found significant correlations between attention bias and interpretation bias, and between interpretation bias and memory bias. These results were supported with bias-corrected

bootstrapping that showed an emotional bias in attention is related to congruent memory bias via interpretation bias. The results supported the CCBH in depression and showed an indirect effect of negative attention biases on memory through a negative interpretation bias (Everaert et al., 2013). The findings support the notion that cognitive biases are interdependent. A cognitive bias at one level of processing can affect subsequent processing stages and works to maintain dysfunctional attitudes (Everaert et al., 2013). According to Everaert et al. (2013), a depressed individual that has an attention bias for negative information allocates more attentional resources to and prioritizes processing negative information first. This leads to negative information being encoded better with extensive elaboration. Extensive elaboration of negative information results in biased interpretation of information, which further activates negative information in memory and consolidates maladaptive beliefs (Everaert et al., 2013).

In a follow up study, Everaert et al. (2014) further supported the CCBH in depression. Again, the results showed that individuals with higher levels of depression had more frequent and longer duration of attention to negative information, interpreted more information negatively, and recalled more negative memories (Everaert et al., 2014). However, in this study a negative attention bias was directly related to a negative memory bias even without the interpretation bias (Everaert et al., 2014). The results from these two studies suggest attention bias is both indirectly and directly related to memory bias (Everaert et al., 2013; Everaert et al., 2014).

Causal Loop Diagram

One theory that conceptualizes the relationship between cognitive biases is the causal loop diagram proposed by Wittenborn and colleagues (2016). This diagram integrates cognitive, biological, social, and environmental factors. One key concept from the causal loop diagram is

the reinforcing feedback loop between attention, interpretation, and memory biases in negative cognitions. The diagram suggests negative cognitive representations stored in long-term memory can direct and maintain attention on negative information leading to an attention bias for negative information. This attention bias is believed to increase the likelihood of information being interpreted negatively. This in turn increases negative affect and enhances encoding of negative information, which further consolidates negative memory representations, perpetuating the feedback loop. In summary, the causal loop diagram suggests cognitive biases are interdependent processes and should not be studied in isolation (Wittenborn et al., 2016).

Attention-Memory-Bias-Interaction Framework

Everaert and colleagues (2018) proposed the Attention-Memory-Bias-Interaction framework, a conceptual framework about how attention and memory biases interact in psychopathology. The framework suggests that attention bias enhances memory for negative stimuli through encoding and retrieval of emotional stimuli. The framework also suggests memory biases influence attention bias towards emotionally congruent stimuli. Everaert et al. (2018) hypothesized that this mutual interaction of attention and memory biases maintain pathogenic cycles in depression through increasingly negative biases in information processing. Emotional biases in attention have been found to modulate encoding of emotional material into long-term memory (Everaert & Koster, 2015). Furthermore, a bias in sustained attention in recollection-based retrieval has been shown to predicate subsequent bias in memory toward emotional material following encoding (Everaert & Koster, 2015). Attention affects controlled forms of retrieval when retrieving emotional stimuli from memory (Everaert & Koster, 2015).

Recently, Everaert and colleagues (2020) laid out research methods for examining the interaction of cognitive biases based on the type of research question of interest (i.e., associative

or causal). For associative questions about cognitive biases, multiple experimental tasks are used in a single study, but the tasks all use the same stimulus materials in a fixed order to show how early biases are related to later processing biases (Everaert et al., 2020). For instance, conducting an attention bias task followed by a memory bias task with the same stimuli can show if a negative attention bias influences encoding and if it is associated with a memory bias for negative stimuli (Everaert et al., 2020). In order to answer causal questions about the biases, the same stimuli should be used across experimental tasks, however cognitive bias modification methods, such as attention training for specific stimuli, must also be used (Everaert et al., 2020).

One study to examine if attention biases and memory bias were causally related was conducted by Blaut et al. (2013). In the study, participants were randomly assigned to either the control group or an attentional training group. Participants in the attentional training group were trained to orient their attention away from negative stimuli. A dot probe task was used to measure attention with negative - neutral word pairs presented simultaneously. A memory task was conducted to assess the impact of attention bias on memory. Participants saw 24 words, 8 in each category (positive, negative, neutral) and rated them on their valance. Following a filler task, participants wrote down as many words as they could recall. Results showed that when trained to orient attention away from negative words, individuals with higher levels of depression did not show a memory bias for negative information, whereas individuals with similar levels of depression in the control (untrained) group did (Blaut et al., 2013). Blaut et al.'s (2013) study indicates that attention bias could be one cause of memory bias in depression. A recent study conducted by Daches and colleagues (2019) supports the causal relationship between attention bias and memory bias. Participants completed 3 weeks of computer-based training that was designed to increase or inhibit attention to negative words. Individuals who were trained to

decrease attention to negative words exhibited significantly less negative bias on a memory test (Daches et al., 2019).

While research supports the existence of and interdependent nature of attention and memory biases in depression or anxiety disorders, no research to date has examined the interaction of these two biases in perfectionism. In regard to perfectionism, research has only investigated attention bias (Howell et al., 2016; Tonta et al., 2019) or memory bias (Besser et al., 2008) separately. Research on the relationship between biases of attention and memory in perfectionism would contribute to our understanding of the cognitive aspects of perfectionism and provide support for theories that suggest cognitive processes and biases are interdependent.

The Present Study

The present study is based on the understanding that cognitive biases in attention and memory exist among people experiencing emotional disorders (Everaert et al., 2018; Grant et al., 2020; Hirsch et al., 2006). This finding is supported by research studies on depression and anxiety that use a series of experimental tasks including dot probe or spatial cueing tasks, interpretation or encoding tasks, and recall or recognition memory tasks (Blaut et al., 2013; Everaert et al., 2014; Everaert et al., 2014; Everaert & Koster, 2020; Everaert et al., 2012; Everaert et al., 2013; Koster et al., 2010; LeMoult & Joormann, 2012; LeMoult et al., 2016; Mathews & MacLeod, 2005). This study examined if these attention biases and memory biases also existed among people high in perfectionism. I investigated how perfectionism predicts attention bias and memory bias for emotional valenced stimuli.

Hypotheses

The aim of the present study was to examine if perfectionists are cognitively biased to process negative information. Specifically, this study aimed to investigate previous findings of

attention bias and memory bias for negative information in perfectionism and how the biases relate to each other. Do perfectionists have an attentional bias for negative information in general or negative perfectionism-relevant information only? Do perfectionists then have a similar memory bias for this negative information? Lastly, this study aimed to examine how biases in attention and memory relate to each other. Do perfectionists have a memory bias for negative information that is mediated by the attention bias, or does it exist regardless of the attention bias?

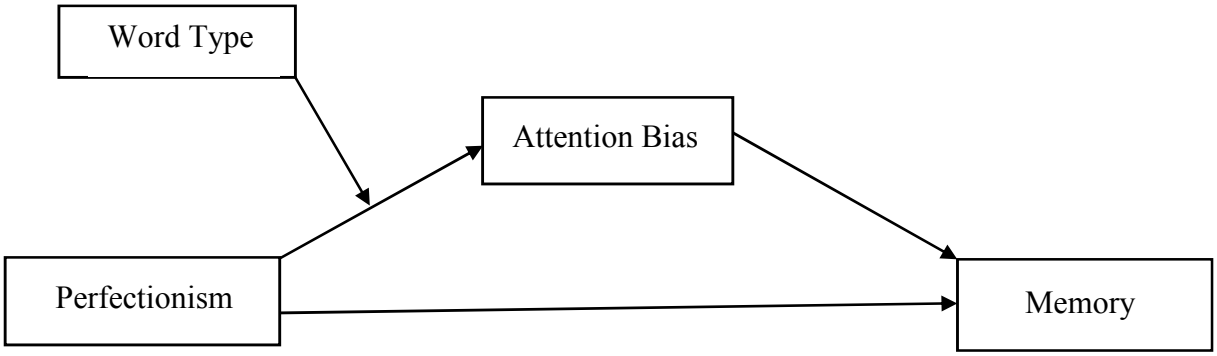
In this study participants completed measures of perfectionism, an attention bias task, and a memory task with positive, negative, and perfectionism-relevant word lists. I used the dot probe task to measure attention bias and a recognition test to measure memory bias for each word type.

For negative and perfectionism-relevant words, I hypothesized that perfectionism would be positively related to memory bias, and that this relation would be mediated by attention bias. Specifically, for negative and perfectionism-relevant words, I hypothesized that perfectionism would be positively associated with attention bias, which would be positively associated with memory bias. I did not expect perfectionism to be related to attention bias for positive words.

In other words, I predicted that word type would moderate the path between perfectionism and attention bias. Specifically, I predicted that perfectionism would be positively associated with attention bias for negative and perfectionism-relevant words but not for positive words. I did not expect word type to moderate the path between perfectionism and memory bias. Figure 1 illustrates this model.

Figure 1

The Moderated Mediation Model Expected For The Present Study.



CHAPTER III: METHOD

Participants

The present study aimed to recruit a minimum of 150 participants based on empirical estimates for the required sample size to detect mediated effects (Fritz & MacKinnon, 2007). Participants were recruited through Illinois State University's Psychology Department participant pool. Participants were self-volunteers who participated for course credit and entry into a raffle for a $25 gift card if they got 75% or more of the trials correct.

A total of 200 Illinois State University students were recruited, although 9 participants were removed for failing attention checks, resulting in a sample of (N = 191) students who participated in the study. The 191 participants included 162 (84.80%) women, 24 (12.60%) men, and 5 (2.60%) who identified as "Other". Additionally, 143 (74.90%) participants identified themselves as White/Caucasian; 23 (12 %) participants identified themselves as Hispanic/Latino or Latina; 10 (5.20%) participants identified themselves as Black/African American; 9 (4.70%) participants identified themselves as Asian/Asian Pacific Islander; and 6 (3.10%) participants identified themselves as "Other". Furthermore, 177 (92.70%) participants learned English as their first language and 14 (7.3%) learned English as a second language. Participants' age ranged from 18 to 34 years, with a mean of 19.19 (SD = 1.74).

Design

The study used a mixed factorial design with perfectionism as a continuous between-subjects variable and word type—negative, positive, perfectionism-relevant, and neutral—as a within-subjects variable. Attention bias and memory bias were dependent variables.

Measures

Word Lists

Positive, negative, neutral, and perfectionism-relevant word lists from Besser et al. (2008) were used in this study (Appendix A). Each list type contained 20 words. The positive list contained items such as *happy, wonderful,* and *enjoyable*. The negative list contained items such as *depressed, pain,* and *lonely*. The neutral list contained items such as *vitamin, linen,* and *lamp*. The perfectionism-relevant list included items such as *critical, flawless,* and *achieving.* Besser et al. (2008) created the positive and negative lists by having 10 undergraduate students in psychology list words for each category. The neutral list contained words from previous memory research. The perfectionism-relevant words were obtained from Hewitt and Genest (1990) who had 60 university students list adjectives that described a perfectionistic individual and a second group of 94 university students rate the words. Besser et al. (2008) had four independent judges rate 200 words and classify each word into one of the four categories. Besser et al.'s (2008) criterion was 100% agreement, so of the 200 words only the words all four judges rated into the same category were included. The final list included 80 words, 20 words per list type: positive, negative, neutral, and perfectionism-relevant. The same word lists were used for measures of both attention and memory bias. Besser et al.'s (2008) 80-item list was divided into two lists, such that each list contained 40 words with 10 per list type. One list was used for the dot probe task and served as the studied items on the recognition task, whereas the second list served as the distractors for the recognition task. Twenty additional neutral words from Zhang et al. (2017) were used for practice trials and as neutral words in the pairs on the dot probe task (Appendix B). Zhang et al. matched all word lists for emotional valence and arousal. The studied and distractor lists were counterbalanced across participants, where each list was used as the study list an equal

number of times. Furthermore, for both the attention bias task and memory bias task, word order was randomized across participants.

Attention Bias

A dot probe task was used to measure attention biases for three experimental categories of words—positive, negative, and perfectionism-relevant—while neutral-neutral pairs were used as a baseline. For the three experimental categories, each of the emotional target words was paired with a neutral word. The dot probe task measures attentional preferences for word pairs by comparing response times to probes presented in the location of the target word with probes presented in the location of the neutral word. The dot probe task assessed attention bias over 160 trials; each stimulus word was presented four times. Presentation order was randomized. As Figure 2 illustrates, each experimental trial started with a fixation display followed by one target word (positive, negative, or perfectionism-relevant) and neutral word pair (baseline trials used two neutral words) presented on the left or right side of the screen for 1000 ms. One of the stimulus items appears to the left and one to the right of the center of the screen. The target word appeared on each side of the screen with equal frequency. After the word pairs disappeared from the screen, a dot probe appeared in either of the two screen locations (left or right). The dot probe appeared on each side of the screen with equal frequency. Participants made a response based on which side of the screen the dot probe is on by pressing a designated key on a standard keyboard. Participants' response latency to accurately identify the location of the dot probe was recorded. In accordance with prior dot probe research, only trials with correct responses were analyzed (Howell et al., 2016; LeMoult & Joorman, 2012; Tonta et al., 2019). Dot probe data was trimmed for outliers such that, response times less than 100 ms were excluded on the rationale that it is not possible to detect the probe and have a motor response in less than 100 ms (Salem et al.,

2018) as these are considered anticipation errors (Gotlib et al., 2004), and responses longer than 2000 ms were removed (Koster et al., 2004) as these are considered lapses of concentration (Gotlib et al., 2004). Error rates were less than 3% across participants. A shorter response latency or quicker response time when the dot probe appears in the location of the target word relative to the neutral word indicates increased attention to the target word of each pair. An attention bias score was calculated using the average response time for each condition, such that a higher score reflects a greater attentional bias. Attention bias scores for each word type were calculated with the traditional attentional bias score formula (Macleod & Mathews, 1988), which is a mean difference score that uses mean response time for congruent and incongruent trials. The traditional measure for attention bias continues to be the most commonly used formula for assessing attention bias on the dot-probe task (Molloy & Anderson, 2020) and with emotional stimuli (Caudek et al., 2017; Cooper & Langton, 2006).

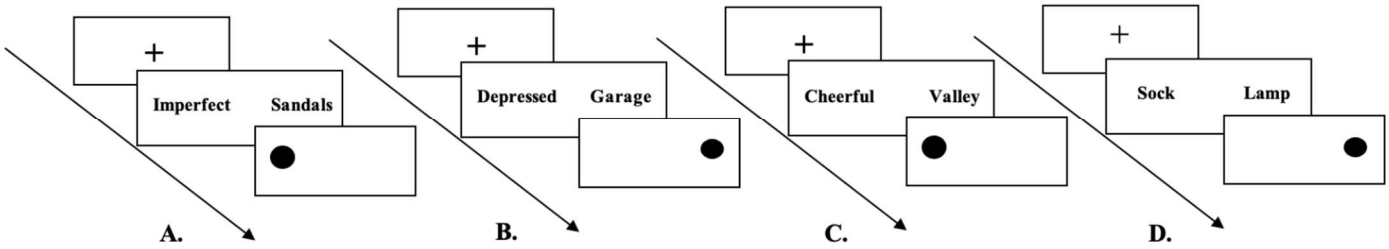
Average response times (RT) were calculated for each word type (positive, negative, perfectionism-relevant) when the dot probe was in the same location as the target word type (congruent) and when the dot probe was in the opposite location from the target word type (incongruent). Attention bias was calculated with the following formula:

$$Attention\ Bias = RT_{Incongruent} - RT_{Congruent} \quad (1)$$

A higher score indicates a greater attentional bias towards the emotional stimuli, whereas lower and negative values indicate attention is directed away from the emotional stimuli.

Figure 2

Sample Dot Probe Format For Each Word Type, Perfectionism-relevant (a), Negative (b), and Positive (c) Paired With A Neutral Word, and Neutral-Neutral Baseline (d).



Note. Congruent conditions are when the dot probe replaces the target emotional word (a and c), and incongruent conditions are when the dot probe replaces the neutral word (b).

Distractor Task

A distractor task was presented between the dot probe and memory task to avoid priming and eliminate the recency effect. This task consisted of 1-min modified dot probe trials, based on Blaut et al.,'s (2013) filler task. Instead of target and neutral word pairs, the word "Right" or "Left" was presented in the center of the screen for 500 ms, followed by the dot probe in either the right or left side of the screen. Participants pressed the corresponding arrow keys to indicate which side the dot probe was located on. The distractor task contained both congruent (e.g., word "Right" appears, dot probe located on right side) and incongruent trials (e.g., word "Right" appears, dot probe located on left side).

Memory Bias

A recognition test was used to assess memory bias using the same word lists from the dot probe attention bias task, thus keeping in line with current research practices for assessing more than one cognitive bias (Everaert et al., 2020; Grant et al., 2020). The dot probe task was considered the *study phase* where the word lists are presented. The 1-min distractor task was

included to eliminate the recency effect. The recognition test included 40 words: 20 previously studied words (5 of each word type, randomly selected) and 20 distractor words (5 of each word type, randomly selected) not previously studied (Appendix B). The words were presented one at a time. As each word was presented, participants had to identify if the word was previously studied (in the dot probe task) or not. The memory recognition score was calculated by the proportion of hits (correctly identified words) minus false alarms (words participants identified as being previously studied but were not actually). This score was calculated for each participant for each word type.

Perfectionism

The Perfectionism Cognitions Inventory (PCI; Flett et al., 1998) was used to measure the frequency of automatic thoughts and perfectionism cognitions (see Appendix C). The PCI is a unidimensional, 25-item measure that assesses the frequency of automatic perfectionism-related thoughts over a week. The instructions state to indicate how frequently the 25 thoughts have occurred over the last week on a scale from 0 (*not at all*) to 4 (*all of the time*). PCI scores are calculated by adding the ratings for each item together, such that higher scores indicate more frequent perfectionism cognitions and higher levels of perfectionism. All 25 items were selected following extensive item analysis (Flett et al., 1998), and research shows PCI scores to have strong validity (Flett et al., 2007; Flett et al., 2002). Normative data for the PCI show an average score for university students of 42.50 (*SD* = 21.25), an average score for the community of 38.51 (*SD* = 18.94), and an average score for psychiatric patients of 44.89 (*SD* = 23.71) (Flett et al., 1998). In the current study, Cronbach's coefficient alpha was .93.

Procedure

Participants were recruited through Illinois State University's Department of Psychology participant pool. Participants received credit that can be used in their psychology courses. The experiment was conducted online using the Gorilla Experiment Builder (Anwyl-Irvine et al., 2019). All participants signed up on SONA and were directed to the experiment via a link. Participants completed the experiment on their own computers. Of the 191 participants, 103 (53.90%) ran the study using Mac OS; 84 (44.0%) used Windows 10; and 4 (2.10%) used Chromium OS.

All participants read a consent form and indicated their consent electronically. Instructions appeared on screen describing the goal of the dot probe task. Participants were asked to look at the words presented on the screen and then to indicate which side of the screen the dot is located on as quickly and accurately as possible. Participants were instructed to press the letter "A" on their keyboard if the dot is on the left and the letter "L" on their keyboard if the dot is on the right. There were five practice dot-probe trials with neutral words only followed by the 160 experimental trials; each stimulus word was presented four times. Following all 160 trials of the dot probe task, participants completed the 1-min right or left dot probe trials as the distractor task. Then participants completed the recognition task during which they identified if each word was presented during the dot probe task by pressing the "L" key or if it is a new word by pressing the "A" key on their keyboard. After completing both cognitive bias tasks, participants completed the PCI to measure perfectionism. Participants were debriefed and thanked for their time.

Data Analysis Plan

Attention bias and memory bias scores were computed using the formulas provided. Descriptive statistics such as means and standard deviations were calculated. I also computed correlation coefficients among variables.

To examine my moderation hypothesis predicting attention bias, I conducted four separate mediation analyses, one per word type. Testing mediation separately for each word type allowed for assessing moderated mediation, as moderated mediation would be present if the indirect effects differed from one another. The criterion used to assess statistical significance will be $p \leq .05$.

Regarding mediation, regression analysis examined if the indirect relationship between perfectionism and memory bias (via attention bias) is significant. I conducted four separate mediation analyses, one for each word type (neutral, positive, negative, perfectionism-relevant). Bootstrapping and 95% confidence intervals were used to test the significance of the indirect effects.

CHAPTER IV: RESULTS

Perfectionism Scores (PCI)

PCI scores ranged from 2 to 97 with an average of 57.57 (SD = 18.98). The average PCI score for university students in the current study (M = 57.57, SD = 18.98) is significantly higher than the average PCI score for university students (M = 42.50, SD = 21.25), $t(190) = 10.97$, $p < .001$, $d = .79$; and psychiatric patients (M = 44.89, SD = 23.71), $t(190) = 9.23$, $p < .001$, $d = .67$, reported in the initial study (Flett et al., 1998) norming the PCI. The average PCI score for university students in the present study was also significantly higher than the recent sample of 602 undergraduate students reported by Casale et al. (2020), with an average of 40.53 (SD = 18.53), $t(190) = 12.41$, $p < .001$, $d = .90$.

Attention Bias: Dot Probe Task

Descriptive statistics for the dot probe task are reported in Table 1, and attention bias scores are reported in Table 2. Participants had slightly faster reaction times for congruent conditions across all word types except positive, however these differences were not significant. One sample t-tests were conducted for each attention bias score. Attention bias scores were not significantly different from zero for negative words, $t(190) = 1.72$, $p = .09$, $d = .13$; perfectionism words $t(190) = .33$, $p = .75$, $d = .02$; positive words, $t(190) = -1.17$, $p = .25$, $d = -.08$; or neutral words, $t(190) = 1.40$, $p = .165$, $d = .10$. Reaction times were not significantly different between congruent and incongruent conditions for any word type. Participants' reaction times were similar regardless of the word type and if the dot probe appeared behind the target emotional word or the neutral word. This suggests all categories of words received approximately the same level of attention; no category particularly captured their attention.

Table 1

Descriptive Statistics for Dot Probe Task Reaction Times (in ms)

	Congruent Conditions		Incongruent Conditions	
Word Type	*M*	*SD*	*M*	*SD*
Perfectionism	432.75	92.74	434.05	97.56
Negative	431.63	98.10	438.09	99.26
Positive	434.38	114.37	429.36	92.25
Neutral	424.53	82.87	435.47	117.51

Note. Congruent conditions are when the dot probe is presented in the location of the target word and incongruent conditions are when the dot probe is presented in the location of the neutral word.

Table 2

Descriptive Statistics for Attention Bias Scores

Attention Bias (AB)	*M*	*SD*
AB_Perfectionism	1.30	55.17
AB_Negative	6.45	51.73
AB_Positive	-5.03	59.57
AB_Neutral	5.42	53.62

Note. Attention Bias scores were calculated using the following formula: $RT_{Incongruent} - RT_{Congruent}$

Memory Bias: Recognition Task

Descriptive statistics for the recognition task are reported in Table 3, and memory bias scores are reported in Table 4. Hits were significantly higher for negative words, $t(190) = 5.13$, $p < .001$, $d = .37$, and positive words, $t(190) = 4.62$, $p < .001$, $d = .19$, than neutral words. Studied negative and positive words were more accurately identified as being presented in the task than perfectionism or neutral words. However, false alarms were significantly higher for negative words than positive, $t(190) = 5.66$, $p < .001$, $d = .41$, perfectionism, $t(190) = 5.94$, $p < .001$, $d = .43$, and neutral words, $t(190) = 7.86$, $p < .001$, $d = .57$. Nonstudied words (words not presented in the dot probe task) were more likely to be falsely identified as presented if they were negative.

Table 3

Descriptive Statistics for Recognition Task

	Hits		False Alarms		Correct Rejections	
Word Type	*M*	*SD*	*M*	*SD*	*M*	*SD*
Perfectionism	.56	.28	.37	.28	.63	.28
Negative	.66	.28	.51	.30	.49	.30
Positive	.65	.29	.39	.28	.61	.28
Neutral	.54	.27	.32	.28	.68	.28

Note. Mean proportion of hits were calculated for studied items (presented in dot probe task) correctly identified as present, false alarms were calculated for non-studied items (not presented in dot probe task) falsely identified as present, and correct rejections were calculated for non-studied items (not presented in dot probe task) correctly identified as not present.

One sample *t*-tests were conducted for each memory bias score. Memory bias scores were significantly different from zero for negative words, $t(190) = 5.91$, $p < .001$, $d = .43$; perfectionism words, $t(190) = 7.81$, $p = < .001$, $d = .57$; positive words, $t(190) = 10.10$, $p < .001$, $d = .73$; and neutral words, $t(190) = 8.65$, $p < .001$, $d = .63$. Memory bias scores were also compared to each other. Neutral words exhibited greater bias than negative words ($t(190) = 2.67$, $p = .01$, $d = .19$). Positive words exhibited greater bias than negative words ($t(190) = 3.85$, $p < .001$, $d = .28$) and perfectionism words ($t(190) = 2.86$, $p = .01$, $d = .21$). Significantly greater memory accuracy was shown for positive and neutral words compared to perfectionism and negative words.

Table 4

Descriptive Statistics for Memory Bias Scores

Memory Bias (MB)	*M*	*SD*
MB_Perfectionism	.19	.33
MB_Negative	.15	.34
MB_Positive	.27	.37
MB_Neutral	.22	.35

Note. Memory Bias scores were calculated by the proportion of hits (correctly identified words) minus false alarms (words participants identified as being previously studied but were not actually studied).

Correlations Among Measures

Pearson correlations were calculated among perfectionism, attention bias, and memory bias scores (see Table 5). PCI scores were not significantly correlated with attention bias scores for any word type. Interestingly, attention bias for perfectionism words was negatively correlated with attention bias for negative words, positive words, and neutral words (see Table 5). No other correlations among attention biases were significant.

PCI scores were positively correlated with memory bias for perfectionism words only, (see Table 5). People higher in perfectionism are more likely to show accurate memory for perfectionism-related words compared with people lower in perfectionism. Memory bias for perfectionism words was positively correlated with memory bias for negative words, positive words, and neutral words (see Table 5). Correlations between attention bias and memory bias scores were not significant for their respective word types, suggesting attention and memory are unrelated.

Table 5

Correlations Among Perfectionism, Attention Bias (AB) and Memory Bias (MB) Scores

Measure	1	2	3	4	5	6	7	8	9
1. PCI	_	_	_	_	_	_	_	_	_
2. AB_Perfectionism	.06	_	_	_	_	_	_	_	_
3. AB_Negative	-.05	-.20**	_	_	_	_	_	_	_
4. AB_Positive	.10	-.24**	-.04	_	_	_	_	_	_
5. AB_Neutral	.02	-.22**	-.11	.13	_	_	_	_	_

(Table Continues)

Measure	1	2	3	4	5	6	7	8	9
6. MB_Perfectionism	.16*	.02	.05	.03	.00	_	_	_	_
7. MB_Negative	.08	.08	-.04	-.07	-.04	.25**	_	_	_
8. MB_Positive	.08	.16*	.05	.01	-.14	.40**	.25**	_	_
9. MB_Neutral	.05	-.08	-.02	-.01	-.01	.35**	.39**	.28**	_

*p<.05. **p<.01. ***p<.001.

Additional correlations among perfectionism, hits and false alarms were computed to further explore the relationship between perfectionism and memory (see Table 6). PCI scores were positively correlated with hits for perfectionism words, $r(190) = .20$, $p < .01$, and negative words, $r(190) = .17$, $p < .05$, only. There were no significant correlations among PCI scores and false alarms for either word type. Given the significant correlation between perfectionism and hits for perfectionism words and negative words, and that the proposed model that includes a direct effect of perfectionism on memory bias, four separate OLS regression analyses were conducted to further examine the relationship between perfectionism and memory accuracy, with perfectionism as the predictor variable and hits for each word type as the criterion variable. Perfectionism significantly predicted hits for perfectionism words, $b = .003$, $t(189) = 2.73$, $p = .007$. Perfectionism scores explained a significant proportion of variance in hits for perfectionism words, $R^2 = .04$, $F(1, 189) = 7.44$, $p = .007$. Perfectionism also significantly predicted hits for negative words, $b = .002$, $t(189) = 2.31$, $p = .022$. Perfectionism score explained a significant proportion of variance in hits for negative words, $R^2 = .03$, $F(1, 189) = 5.34$, $p = .022$. Perfectionism did not predict hits for positive words, $b = .001$, $t(189) = .810$, $p = .419$, or neutral words, $b = .001$, $t(189) = .740$, $p = .460$.

Table 6

Correlations Among Perfectionism, Hits, and False Alarms (FA)

Measure	1	2	3	4	5	6	7	8	9
1. PCI	_	_	_	_	_	_	_	_	_
2. Hits_Perfectionism	.20**	_	_	_	_	_	_	_	_
3. Hits_Negative	.17*	.32**	_	_	_	_	_	_	_
4. Hits_Positive	.06	.39**	.31**	_	_	_	_	_	_
5. Hits_Neutral	.05	.39**	.33**	.30**	_	_	_	_	_
6. FA_Perfectionism	.01	.31**	.17*	.13	.18*	_	_	_	_
7. FA_Negative	.06	.17*	.29**	.27**	-.05	.37**	_	_	_
8. FA_Positive	-.05	.22**	.09	.16*	.13	.55**	.42**	_	_
9. FA_Neutral	-.01	.16*	.10	.12	.18*	.48**	.32**	.42**	_

*p<.05. **p<.01. ***p<.001.

Mediation Analyses

In order to test the model's prediction that attention bias would mediate the relationship between perfectionism and memory bias for perfectionism-relevant and negative words, but not for positive and neutral words, I conducted four separate mediation analyses. Mediation analyses were conducted per word type. The predictor or independent variable in each analysis was always perfectionism, defined by PCI score. The mediator variable was attention bias per word type, and the dependent variable was memory bias per word type, such that attention and memory bias were always for the same word type. Mediation analysis allows for testing indirect effects of the independent variable on the dependent variable through the mediator variable.

These indirect effects were tested with bootstrapping procedures. Bootstrapping estimated 10,000 potential indirect effects between the independent variable, perfectionism, and the dependent variable, memory bias, using random samples from the data set. The 10,000 bootstrapped indirect effects are ordered, and the upper and lower points of a 95% confidence interval are used to determine if mediation is supported. If the indirect effect is significantly different from zero, the confidence interval will not include zero. Analyses were conducted using the PROCESS Macro Version 4 (Hayes, 2022) in SPSS. The criterion used to assess statistical significance was $p \leq .05$.

Perfectionism Words

The direct effect between perfectionism/PCI score and memory bias for perfectionism words was significant, $b = .0028$, $p = .0285$. The confidence interval ranged from .0003 to .0053, thus the direct effect was statistically significant.

The relationship between perfectionism and memory bias for perfectionism words was not mediated by attention bias for perfectionism words, however. The *a* path between perfectionism scores and attention bias for perfectionism-relevant words was .186, and the *b* path between attention bias for perfectionism-relevant words and memory bias for perfectionism-relevant words was .00; neither path was significant. As Figure 3 illustrates, the unstandardized indirect effect was (.186)(.0000) = .00. I tested the significance of this indirect effect using bootstrapping procedures. Unstandardized indirect effects were computed for each of 10,000 bootstrapped samples, and the 95% confidence interval was computed by determining the indirect effects at the 2.5^{th} and 97.5^{th} percentiles. The bootstrapped unstandardized indirect effect was .0000, and the 95% confidence interval ranged from -.0003, .0003. Thus, the indirect effect was not statistically significant.

Figure 3

Unstandardized Regression Coefficients for the Relationship Between Perfectionism and Memory Bias as Mediated by Attention Bias for Perfectionism Words

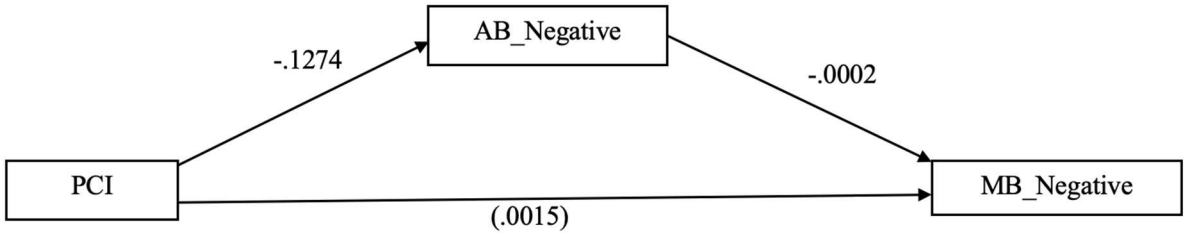
Negative Words

The direct effect between perfectionism and memory bias for negative words was not significant, *b* = .0015, p = .2664. The confidence interval ranged from -.0011 to .0041.

The relationship between perfectionism and memory bias for negative words was not mediated by attention bias for negative words. The *a* path between perfectionism scores and attention bias for negative words was -.1274, and the *b* path between attention bias for negative words and memory bias for negative words was -.0002; neither path was significant. As Figure 4 illustrates, the unstandardized indirect effect was (-.1274)(-.0002) = .00. The bootstrapped 95% confidence interval ranged from -.0002, .0003. Thus, the indirect effect was not statistically significant.

Figure 4

Unstandardized Regression Coefficients for the Relationship Between Perfectionism and Memory Bias as Mediated by Attention Bias for Negative Words



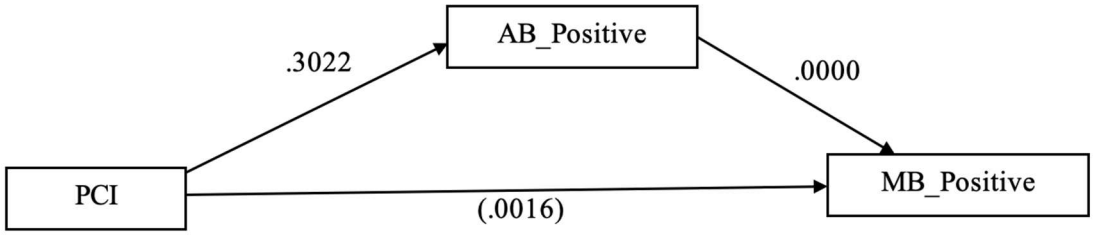
Positive Words

The direct effect between perfectionism and memory bias for positive words was not significant, $b = .0016$, $p = .2576$. The confidence interval ranged from -.0012 to .0044.

As predicted, the relationship between perfectionism and memory bias for positive words was not mediated by attention bias for positive words. The *a* path between perfectionism scores and attention bias for positive words was .3022, and the *b* path between attention bias for positive words and memory bias for positive words was .0000; neither path was significant. As Figure 5 illustrates, the unstandardized indirect effect was (.3022)(.0000) = .00 (95% confidence interval ranged from -.0003, .0005).

Figure 5

Unstandardized Regression Coefficients for the Relationship Between Perfectionism and Memory Bias as Mediated by Attention Bias for Positive Words



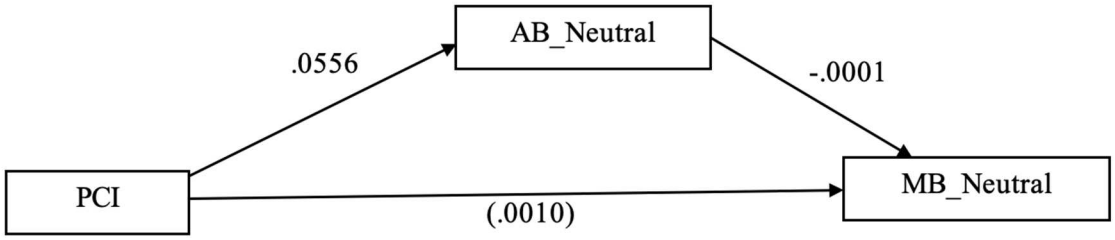
Neutral Words

The direct effect between perfectionism and memory bias for neutral words was not significant, $b = .0010$, $p = .4743$. The confidence interval ranged from -.0017 to .0037.

As predicted, the relationship between perfectionism and memory bias for neutral words was not mediated by attention bias for neutral words. The *a* path between perfectionism scores and attention bias for neutral words was .0556, and the *b* path between attention bias for neutral words and memory bias for neutral words was .0000; neither path was significant. As Figure 6 illustrates, the unstandardized indirect effect was (.0556)(.0000) = .00 (95% confidence interval = -.0003, .0005).

Figure 6

Unstandardized Regression Coefficients for the Relationship Between Perfectionism and Memory Bias as Mediated by Attention Bias for Neutral Words



CHAPTER V: DISCUSSION

Research has demonstrated that perfectionists exhibit cognitive biases of attention and memory; however, these biases were previously only studied in isolation. I examined the extent to which these biases existed and how these biases are related by combining a dot probe and recognition task with four categories of words: perfectionism-relevant, negative, positive, and neutral. Through this experimental study, I found perfectionism was directly related to memory bias for perfectionism words only, and perfectionism predicted hits for perfectionism-relevant and negative words. Attention bias and memory bias were unrelated and, as such, attention bias did not mediate the relationship between perfectionism and memory bias for any word type.

I hypothesized that for negative and perfectionism-relevant words, perfectionism would be positively related to memory bias and that this relation would be mediated by attention bias. The results do not support this hypothesis as the indirect effects were not significant for perfectionism and memory bias for perfectionism-relevant or negative words. I also hypothesized that this relationship would not exist for positive or neutral words. The results support this hypothesis as there was no relationship between perfectionism, attention bias, and memory bias for positive or neutral words. These results contradict past studies that have found attention bias to play a significant role in the relationship between depression and memory bias (Everaert et al., 2013, 2014). Since these studies considered these biases in depression, not perfectionism, one could argue that biases in perfectionism are not as strong and therefore are less likely to show an effect. However, this is an unlikely explanation as several studies have reliably shown attention biases (Howell et al., 2016; Tonta et al., 2019; Tsubota & Ishii, 2019) and memory biases (Besser et al., 2008; Desnoyers, 2013) in perfectionism. One major difference between the current study's hypothesized model and Everaert et al.'s models that could account for this

difference is that Everaert et al.'s model examined attention bias and memory bias via interpretation bias, whereas the current study had attention bias as the mediator. It is possible that attention bias on its own is not sufficient to mediate the relationship between perfectionism and memory but could have an indirect effect in combination with interpretation bias. A negative interpretation bias is when ambiguous stimuli are more likely to be perceived as negative than positive. By interpreting stimuli as negative, those stimuli undergo a more elaborative encoding process which allows them to be better remembered. Two studies have shown this interpretation bias exists in perfectionists which lends support to this explanation (Howell et al., 2019; Yiend et al., 2011). However, no studies to date have examined interpretation bias in relation to attention and memory bias in perfectionism. Filling this gap in the literature would be an important next step in this line of research.

Perfectionism was unrelated to attention bias, regardless of word type. Overall, participants had slightly faster reaction times for congruent conditions across all word types except positive, however these differences were not significant. Participants' reaction times were faster for negative congruent conditions compared to negative incongruent conditions, while this difference trended in the predicted direction and approached significance, it was not significant. Contrastingly, reaction times were faster for positive incongruent conditions compared to positive congruent conditions, although this difference was not significant. These two trends while not significant are in line with past research that suggests negative information engages or draws our attention, leading to faster congruent reaction times, whereas positive information is discounted, leading to faster incongruent reaction times. Overall, attention bias results contradict past research which found evidence that perfectionists had strong attention biases towards negative stimuli (Howell et al., 2016; Tonta et al., 2019; Tsubota & Ishii, 2019) using a dot probe

task. One methodological difference that could account for this difference is the current study was conducted online whereas past studies ran participants through the dot probe task in a controlled laboratory setting. Participants' error rates on the dot probe task in the current study were low, less than 3%, suggesting a high level of accuracy on the task. One possibility is that participants were able to ignore the words and focus solely on the dot, allowing for a high degree of accuracy without showing differences in their attention. Additionally, the previous studies conceptualized perfectionism using variations of the Frost Multidimensional Perfectionism Scale (FMPS) whereas the current study used the PCI. Another possibility is the PCI and the FMPS measure different aspects of perfectionism, and perhaps the aspects measured by the FMPS are more closely linked with cognitive biases in perfectionism.

The current study did find evidence for the direct relationship between perfectionism and memory bias for perfectionism-relevant words. Perfectionism also predicted hits for perfectionism-relevant and negative words and did not predict hits for positive or neutral words. This supports past research showing perfectionists had more accurate memory for perfectionism-relevant and negative words (Besser et al., 2008). This suggests perfectionism does have an effect on memory. Future research should explore if word type would moderate the direct path between perfectionism and memory. In the current study participants exhibited a more liberal response bias for negative items, meaning they were more likely to say they remembered negative items, even if they weren't presented. This finding is consistent with past research that suggests negative words elicit more old judgements on standard recognition tests than positive or neutral words (Dougal & Rotello, 2007), especially in young adults (Kapucu et al., 2008). Research suggests this effect for negative words is caused by category membership, such that a more liberal response bias is used when more words on the list belong to the negative emotion

category (White et al., 2014). In the current study, a portion of the perfectionism-relevant words could also be considered negative. It is possible these additional words with negative connotations added to the number of negative words present, thus increasing the potential for a liberal response bias for negative words.

I also predicted that word type would moderate the path between perfectionism and attention bias. The current study's findings do not support the moderation hypothesis, as the indirect effects of each word type were not significantly different from one another. One possible explanation for this lies in the characteristics of perfectionism. Perfectionists strive to perform exceptionally well on tasks. The dot probe task requires both accuracy and efficiency, it is possible that perfectionists' desire to do well on the overall task overrode their potential bias towards specific words. Past studies have found attention biases in perfectionists using a dot probe task, however our sample scored unusually high for perfectionism, so perhaps these biases exist at lower levels of perfectionism but at higher levels of perfectionism these biases can be overridden by the desire to perform perfectly, especially when motivated by the knowledge your performance is being scored or the possibility to win a gift card for more correct answers. Another possibility for word type failing to moderate the path between perfectionism and attention bias could be in the experimental setting. Perhaps completing the task online versus in a lab with an experimenter observing your performance fundamentally changes aspects of perfectionism. Completing the task online may reduce socially prescribed perfectionism, anxiety, or concerns for mistakes thus reducing aspects of perfectionism associated with previously found attention biases.

Limitations of the Present Study

One limitation of the present study was that the average PCI score was abnormally high for a sample of university students. The current study's average for perfectionism cognitions was significantly higher than past studies of university students and psychiatric samples. However, all the prior studies I reviewed using the PCI were conducted before the COVID-19 pandemic. It is possible that college students after encountering and continuing to encounter challenges with college education, social isolation, and uncertainty about the future associated with the pandemic, have increased in their levels of perfectionism cognitions. Thoughts such as *Things are seldom perfect*, *I have to work hard all the time*, *I should be doing more* or *How well am I doing*?, may be more common during these exceptional times. Recent studies report dramatic increases in college students' symptoms of depression and anxiety during the pandemic (Fruehwirth et al., 2021; Hawes et al., 2021; Lee et al., 2021). Additionally, perfectionism itself has been continuing to increase in college students (Curran & Hill, 2019). From 1989 to 2016, levels perfectionism have linearly increased in college students, even when controlling for gender and country differences (Curran & Hill, 2019). The significant increase for perfectionism scores found in the current study could be evidence of this trend of perfectionism linearly increasing continuing from 2016 to 2021.

Another limitation of the present study was the use of the dot probe task to measure attention bias. There are concerns with both the dot probe task and the traditional attention bias formula's reliability. One suggestion to improve reliability is to include more trials and have participants complete multiple sessions (Aday & Carlson, 2019). However, this presents practical challenges of participant fatigue and attrition. Researchers have also suggested computational

modeling (Price et al., 2019) or response-based computation (Evans et al., 2018) approaches to analyzing dot probe data to improve reliability and validity.

Additionally, since the study was conducted during the COVID-19 pandemic, data collection was conducted online instead of the initially planned in-person lab setting. There are concerns with measuring attention outside of the lab as I could not control the environment participants completed the study in or assess the level of focus they gave the task. It is possible that many participants completed the study in highly distracting environments that divided their attention or were able to simply "go through the motions" of the study by clicking keys randomly through. However, Gorilla records reaction times per trial, time spent per task (dot probe, recognition, PCI), and total experiment time. Participants with completion times that were considered too fast or too slow, or who appeared to leave the study and come back, were identified and removed before data analysis.

Another limitation was this study only examined if a relationship existed between attention bias and memory bias in perfectionism and did not look at the potential causal relationship. Future research should consider manipulating attention using the dot probe task to attempt to induce memory bias for different categories of words to determine if attention bias has a causal relationship with memory bias in perfectionism.

Implications

These research questions are important and have several implications. First, it is important to examine cognitive biases in other disorders or traits beyond depression and anxiety. Further developing our understanding of cognitive biases contributes to our knowledge of cognitive processes and the factors that can impair or distort these processes. It is also necessary to provide evidence for the attention-memory-bias-interaction framework (Everaert et al., 2018,

2020; Evereart & Koster, 2020) beyond depression studies and further support the combined cognitive biases hypothesis.

Second, having an understanding of these biases in perfectionism will have implications for our understanding of perfectionism. Perfectionism is linked with various negative health outcomes (Molnar et al., 2018) and is increasingly more common (Curran & Hill, 2019). Cognitive biases are viewed as critical components in both contributing to and maintaining mental health problems (Egan et al., 2011; Flett & Hewitt, 2002; Smith et al., 2014). If these biases are related to perfectionism, as they are to depression, the biases could be contributing to these negative outcomes. Negative cognitive biases have been linked to negative mood, feelings of worthlessness or failure, and more pessimistic attitudes (Marchetti et al., 2019). These biases have also been shown to encourage depressotypic processing styles which can lead to an increase in depression symptom severity (Duyser et al., 2020). Perfectionistic concerns have also been shown to predict increases in depressive symptoms (Smith et al., 2021). Furthermore, perfectionism can negatively impact therapy or treatment outcomes, from difficulties in initially seeking treatment to a stronger resistance to change (Dang et al., 2020, Hewitt et al., 2020). Additional support for the tie between cognitive biases and negative mental health outcomes comes from studies that show cognitive behavioral therapies that are designed to address cognitive biases have been successful in reducing perfectionism, depression, and anxiety (Shafran et al., 2010; Steele et al., 2013).

Third, it is important to examine how stimulus type might moderate the relationship between perfectionism, attention bias, and memory bias. Research has shown attention biases for both negative perfectionism-relevant information (Howell et al., 2016) and negative information in general (Tonta et al., 2019), whereas memory bias has been shown for negative information in

general (Besser et al., 2008). My research question was whether these biases extended to negative information in general or if they are perfectionism-specific. Knowing the extent of the biases will provide a greater understanding of the factors that contribute to the negative outcomes of perfectionism.

Finally, it is important to examine if attention bias mediates the relationship between perfectionism and memory bias. If the only relationship between perfectionism and memory bias is through attention bias, then cognitive behavioral therapy and cognitive modification training can primarily focus on attention bias with the expectation that memory bias will improve as a result of improving attention.

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APPENDIX A: BESSER ET AL. (2008) WORD LISTS

Perfectionism-relevant	
1. Precise	11. Flawless
2. Demanding	12. Diligent
3. Competitive	13. Exceptional
4. Preserving	14. Ambitious
5. Picky	15. Strict
6. Complete	16. Achieving
7. Orderly	17. Imperfect
8. Exacting	18. Proper
9. Organized	19. Thorough
10. Driven	20. Critical
Positive	
1. Happy	11. Enthusiastic
2. Amusing	12. Enjoyable
3. Calm	13. Carefree
4. Friendly	14. Cheerful
5. Energetic	15. Excite
6. Pleasant	16. Contented
7. Relaxed	17. Gaiety
8. Courageous	18. Certain
9. Decisive	19. Courteous
10. Wonderful	20. Polite
Negative	
1. Embarrassed	11. Sadness
2. Terrible	12. Horrible
3. Depressed	13. Miserable
4. Desperate	14. Worried
5. Pain, suffering	15. Tragedy
6. Rejected	16. Guilt
7. Stupid	17. Lonely
8. Hesitant	18. Fragile
9. Sad	19. Tense
10. Testy	20. Hostile
Neutral	
1. Butter	11. Orange
2. Factory	12. Car
3. Guest, visitor	13. Swimming-pool
4. Liquid	14. Table
5. Pianist	15. Cake
6. Wagon	16. Computer
7. Vitamin	17. Lamp
8. Cheetah	18. Linen
9. Shirt	19. Elections
10. dollar	20. Green

APPENDIX B: WORD LIST FOR DOT PROBE AND RECOGNITION TASK EXAMPLE

Dot Probe Task Pairs

Target Words	Neutral Pair 1	Neutral Pair 2	Neutral Pair 3	Neutral Pair 4
Perfectionism				
Flawless	Sandals	Rhythm	Ankle	Orange
Imperfect	Cheetah	Linen	Radio	Liquid
Critical	Cake	Pianist	Steep	Table
Achieving	Sound	Computer	Highway	Dollar
Ambitious	Climber	Butter	Swimming	Range
Exceptional	Walk	Garage	Vitamin	Guest
Demanding	Boot	Truck	Wagon	Symphony
Competitive	Instrument	Peak	Factory	Vehicle
Strict	Car	Lamp	Shirt	Green
Organized	Valley	Elections	Melody	Summit
Positive				
Happy	Sandals	Pianist	Shirt	Green
Wonderful	Computer	Highway	Range	Vehicle
Enjoyable	Butter	Cheetah	Radio	Truck
Cheerful	Garage	Lamp	Car	Symphony
Friendly	Vitamin	Guest	Linen	Walk
Pleasant	Sound	Wagon	Steep	Ankle
Relaxed	Elections	Dollar	Orange	Peak
Courageous	Swimming	Valley	Climber	Boot
Enthusiastic	Summit	Table	Rhythm	Instrument
Amusing	Factory	Melody	Liquid	Cake
Negative				
Depressed	Computer	Swimming	Highway	Symphony
Rejected	Walk	Liquid	Ankle	Truck
Lonely	Peak	Radio	Lamp	Sound
Miserable	Cheetah	Valley	Instrument	Vehicle
Worried	Steep	Orange	Table	Range
Tragedy	Boot	Wagon	Rhythm	Climber
Hostile	Garage	Guest	Pianist	Cake
Guilt	Factory	Shirt	Car	Linen
Stupid	Sandals	Vitamin	Dollar	Green
Suffering	Melody	Butter	Elections	Summit
Neutral				
Band	Computer	Orange	Truck	Sandals
Hill	Dollar	Cheetah	Summit	Ankle
Top	Table	Pianist	Boot	Vehicle
Drive	Shirt	Vitamin	Garage	Walk
Kick	Swimming	Wagon	Symphony	Climber
Sedan	Lamp	Guest	Steep	Valley

Sock	Cake	Liquid	Melody	Range
Jeep	Elections	Factory	Highway	Instrument
Jazz	Car	Rhythm	Peak	Sound
Shoe	Linen	Butter	Radio	Green

Recognition Task

Word Type	**Studied**	**Non-studied**
Perfectionism	1. Flawless 2. Imperfect 3. Critical 4. Achieving 5. Exceptional	1. Driven 2. Exacting 3. Orderly 4. Complete 5. Precise
Positive	1. Happy 2. Amusing 3. Relaxed 4. Cheerful 5. Friendly	1. Carefree 2. Calm 3. Energetic 4. Contented 5. Polite
Negative	1. Depressed 2. Suffering 3. Miserable 4. Guilt 5. Lonely	1. Sadness 2. Horrible 3. Desperate 4. Embarrassed 5. Terrible
Neutral	1. Factory 2. Boot 3. Computer 4. Orange 5. Steep	1. Concert 2. Automobile 3. Knee 4. Ski 5. Bus

Dot Probe Practice Trials

Neutral – Neutral Word Pairs (Words not used anywhere else)	
Rock	Square
Line	Soup
Plastic	Shade
Measure	Glacier
Curtain	Wheel

APPENDIX C: PERFECTIONISM COGNITIONS INVENTORY

Listed below are a variety of thoughts about perfectionism that sometimes pop into people's heads. Please read each thought and indicate how frequently, if at all, the thoughts occurred to you over the last week. Please read each item carefully and choose the appropriate number using the scale below.

0 = Not At All 4 = All Of The Time

1. Why can't I be perfect…… 0 1 2 3 4
2. I need to do better……... 0 1 2 3 4
3. I should be perfect……..... 0 1 2 3 4
4. I should never make the same mistake twice.…… 0 1 2 3 4
5. I've got to keep working on my goals……... 0 1 2 3 4
6. I have to be the best…… 0 1 2 3 4
7. I should be doing more……..….. 0 1 2 3 4
8. I can't stand to make mistakes……...……. 0 1 2 3 4
9. I have to work hard all the time…….…… 0 1 2 3 4
10. No matter how much I do, it's never enough……. 0 1 2 3 4
11. People expect me to be perfect…….…….. 0 1 2 3 4
12. I must be efficient at all times……...……. 0 1 2 3 4
13. My goals are very high…….…….. 0 1 2 3 4
14. I can always do better, even if things are almost perfect…… 0 1 2 3 4
15. I expect to be perfect.....……..…… 0 1 2 3 4
16. Why can't things be perfect?……..…… 0 1 2 3 4
17. My work has to be superior……...……. 0 1 2 3 4
18. It would be great if everything in my life was perfect...……. 0 1 2 3 4
19. My work should be flawless……..……. 0 1 2 3 4
20. Things are seldom ideal…….…… 0 1 2 3 4
21. How well am I doing?.....……. 0 1 2 3 4
22. I can't do this perfectly……..……. 0 1 2 3 4
23. I certainly have high standards……..……. 0 1 2 3 4
24. Maybe I should lower my goals…….…… 0 1 2 3 4
25. I am too much of a perfectionist……. 0 1 2 3 4