The Role of Metacognitive Beliefs and the Cognitive Attentional Syndrome in the Development of Anxiety Symptoms: A Cross-Lagged Panel Design

by

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Abstract

The metacognitive model of emotional disorders suggests that the cognitive attentional syndrome (CAS; i.e., a set of seven maladaptive self-regulation strategies) is activated by one's beliefs about their own thoughts, otherwise referred to as metacognitive beliefs. Two types of metacognitive beliefs have been considered particularly important for activating the CAS: positive metacognitive beliefs and negative metacognitive beliefs. According to this model, the habitual use of CAS strategies exacerbates emotional distress, leading to the development of emotional disorders such as anxiety disorders. While research has shown that CAS strategies and metacognitive beliefs are strongly related to anxiety symptoms, there has been limited evidence supporting the assertion that maladaptive metacognitive beliefs activate the CAS, which leads to anxiety. Additionally, no known study has examined the distinct roles that these two different types of metacognitive beliefs play in CAS activation and anxiety. To provide further support for the metacognitive model and fill this gap in the literature, the present study sought out to examine the mediating role of the CAS in the relationships between positive and negative metacognitive beliefs and anxiety. A large sample of adult participants (N = 573) completed an online self-report battery at three time points across seven months. A series of path analyses showed that time 2 CAS activation mediated the relationship between time 1 negative metacognitive beliefs and time 3 anxiety. This effect was specific to negative metacognitive beliefs, as the longitudinal path across time 1 positive metacognitive beliefs, time 2 CAS activation, and time 3 anxiety was non-significant. Thus, negative metacognitive beliefs may be more important to CAS activation and subsequent anxiety than positive metacognitive beliefs. Study findings suggest that it may be especially important to focus on negative

metacognitive beliefs and the CAS in anxiety treatment, as is done in Metacognitive Therapy (MCT).

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Anxiety disorders are consistently considered one of the most prevalent classes of mental health concerns across the developed world and are associated with extensive health care costs and a high burden of disease (Bandelow & Michaelis, 2015). Given the high prevalence rates and the toll these disorders have, it will be important to identify factors that may contribute to the maintenance and exacerbation of anxiety. The metacognitive model of emotional disorders is one such model that has been developed to explain the development and maintenance of anxiety disorders. Specifically, the metacognitive model posits that metacognitive beliefs (i.e., beliefs about thinking) activate a set of maladaptive self-regulation strategies referred to as the Cognitive Attentional Syndrome (CAS). According to this theory, the habitual and prolonged use of these strategies maintains and exacerbates emotional distress, resulting in the development and maintenance of emotional disorders (e.g., anxiety disorders; Wells, 2011; Wells & Matthews, 1996). While the metacognitive model suggests that metacognitive beliefs activate the CAS, no known study has longitudinally tested this assertion. Given that the metacognitive model has played such a significant role in expanding our understanding of the etiology, maintenance, and treatment of anxiety and other emotional disorders (e.g., Metacognitive Therapy; Wells, 2011), it will be important to provide evidence of this central principle. As such, the primary aim of the present study is to test the metacognitive model by examining whether CAS activation longitudinally mediates the relationships between positive and negative metacognitive beliefs and anxiety.

Anxiety Disorders

As mentioned, anxiety disorders have been identified as one of the most prevalent classes of psychiatric disorders in the United States and across the developed world (Bandelow & Michaelis, 2015; Simpson et al., 2010; Wittchen et al., 2011). In addition to high prevalence rates, recent research has provided evidence that rates of anxiety disorders continue to climb year by year (Goodwin et al., 2020). Globally, 301.39 million individuals were estimated to have been diagnosed with an anxiety disorder in 2019 (Yang et al., 2021). Moreover, this rate was reported to have increased from 194.92 million to 301.39 million since 1990. Regarding national rates, one study from 2010 reported that the overarching domain of anxiety disorders was the most prevalent class of mental and neurological disorders in the European Union (Wittchen et al., 2011). Further, prevalence estimates suggest that up to 18% of Americans will experience an anxiety disorder in a given year and over 30% of the population will be burdened with an anxiety disorder at one point during their lifetime (Kessler et al., 2005). In addition to the high rates of individuals who meet diagnostic criteria for anxiety disorders, recent work has evidenced increasing prevalence rates of subthreshold anxiety (e.g., Witlox et al., 2021). One recent meta-analysis conducted by Witlox and colleagues (2021) found that for several types of anxiety disorders (e.g., generalized anxiety, panic, and specific phobia), subthreshold symptomatology was significantly more prevalent than the corresponding clinical disorder, while for other types of anxiety disorders, subthreshold anxiety and anxiety disorders did not significantly differ (e.g., agoraphobia and social anxiety).

Beyond the pervasiveness of anxiety disorders, the presence of an anxiety disorder has been associated with staggering economic burden. For example, annual medical expenditures due to anxiety disorders in 2010 were estimated to be approximately $33.71 billion in the United States (Shirneshan et al., 2013) and over €74.4 billion across Europe (Gustavsson et al., 2011).

Additionally, a recent meta-analysis reported that anxiety disorders were associated with a low proportion of health care costs on a population level, but significantly increased health care costs on an individual level compared with individuals without anxiety (Konnopka & König, 2020). Similarly, findings from the Global Burden of Disease (GBD) Study of 2019 found that the number of disability adjusted life years associated with anxiety disorders has grown from an estimated 18.66 million in 1990 to 28.68 million Disability-Adjusted Life Years (DALYs) worldwide (Yang et al., 2021). In addition to the emotional and economic burden experienced by individuals with anxiety disorders, these individuals have been found to experience worsened physical health and increased bodily pain and discomfort, decreased levels of interpersonal functioning, and decreased job performance (Hoffman et al., 2008). Given the growing prevalence rates of anxiety disorders and substantial burden associated with experiencing anxiety, researchers in the field have called for the development and empirical evaluation of theories which can account for the development and maintenance of clinically significant anxiety.

The Metacognitive Model

The metacognitive model posits that emotional disorders (e.g., anxiety disorders) emerge as a result of metacognitive beliefs, which activate the CAS (Wells, 2011; Wells & Matthews, 1996). Metacognitive beliefs are beliefs about one's own thinking (Wells, 2011; Wells & Cartwright-Hatton, 2004). According to Wells (2011), two types of metacognitive beliefs are especially important for activating the CAS: positive metacognitive beliefs and negative metacognitive beliefs. Positive metacognitive beliefs are beliefs that highlight the benefits and value of engaging in CAS-related self-regulation strategies (e.g., "worrying helps me to avoid problems in the future" and "scanning the room for danger will help keep me safe"). On the other

hand, negative metacognitive beliefs emphasize the uncontrollability and danger of thoughts and CAS-related self-regulation strategies (e.g., “I cannot control my worrying thoughts” and “Suppressing my thoughts is dangerous for me”). According to the metacognitive model, positive metacognitive beliefs highlight the benefits of using maladaptive CAS-related self-regulation strategies, which increases the likelihood that unwanted/uncomfortable cognitive events come into awareness rather than going unnoticed (Wells, 2011). When this happens, the individual will likely persist in using avoidance-focused self-regulation (i.e., CAS) strategies to alleviate the resulting distress, which in turn strengthens maladaptive metacognitive beliefs and use of CAS-related self-regulation.

Having negative metacognitive beliefs makes it more likely that the individual will experience relatively benign intrusive thoughts or images as signs that something is wrong or that they may be “losing their minds.” Holding negative metacognitive beliefs may increase the likelihood that the individual will monitor their thoughts for signs that something is wrong, especially in times of increased stress. This may exacerbate symptoms given that increased monitoring surrounding one’s original concern tends to further exacerbate emotional distress due to a perceived confirmation of feared outcomes (e.g., losing control of thoughts). According to Wells (2011), engagement with these metacognitive beliefs is theorized to activate the CAS.

The Cognitive Attentional Syndrome (CAS)

As described, CAS strategies are employed to regulate and control one’s emotional and cognitive experiences. The maladaptive self-regulation strategies that characterize the CAS include worry, rumination, internal threat monitoring, external threat monitoring, thought suppression, physical avoidance behaviors, and substance use (Wells, 2011). This regulation

style has been shown to be maladaptive by prolonging negative emotional states, strengthening maladaptive thoughts and perceptions, and preventing adaptive long-term learning (Wells, 2011).

An example of the CAS in action can be understood within the context of generalized anxiety. According to the metacognitive model, holding positive (e.g., “worrying will help me anticipate possible future problems") and/or negative metacognitive beliefs (e.g., “worrying means that I am going crazy”) increases the likelihood that the CAS is activated in response to external and internal (e.g., intrusive negative thoughts) threat stimuli (Wells, 2005, 2011). For example, the individual may view worry as a strategy to anticipate or cope with future problems. By doing so, the individual may learn to habitually utilize these maladaptive coping strategies to reduce feelings of distress and negative emotions in everyday practice (e.g., “Worrying now will better prepare me for later”). While using these strategies may be perceived as helpful in the short-term, ultimately the habitual engagement of these strategies may cause more harm in the long-term. Specifically, this would prevent the individual from learning that these strategies are not necessary to prevent the feared outcome and decrease the likelihood of developing adaptive coping skills. On the other hand, negative metacognitive beliefs about the uncontrollability and danger associated with their worries will likely lead to negative interpretation of worry, subsequently increasing emotional distress about the continued presence of worry thoughts. These maladaptive self-regulation strategies may prolong anxious arousal and emotional distress and prevent the individual from learning that a particular stimulus or situation is relatively safe and that the individual is able to use adaptive coping in response to uncomfortable internal experiences. This in turn may result in the development of psychopathology (e.g., generalized anxiety disorder; Wells, 2011).

The Link Between Metacognitive Beliefs and Anxiety

Consistent with the metacognitive model, research has supported the link between metacognitive beliefs and anxiety pathology. Metacognitive beliefs have been implicated in a wide range of symptom presentations including generalized anxiety (Wells & Carter, 1999, 2001), health anxiety (Bailey & Wells, 2016; Melli et al., 2016, 2018), panic (Cucchi et al., 2012; Morrison & Wells, 2003; Wells & Carter, 2001), social anxiety (Gavric et al., 2017; Wells & Carter, 2001; Wong & Moulds, 2010), and obsessive-compulsive symptoms (Cucchi et al., 2012; Wells & Papageorgiou, 1998). Moreover, an abundance of past research has provided evidence that negative metacognitive beliefs may be particularly relevant for the pathogenesis of anxiety disorders. For example, Cartwright-Hatton and Wells (1997) found that negative metacognitive beliefs held the strongest associations with health, social, and trait anxiety among all domains of metacognitive beliefs. Similarly, among all metacognitive belief domains, negative metacognitive beliefs were found to be the most highly associated with increased levels of anxiety and perceived stress (Ramos-Cejudo & Salguero, 2017).

With regard to prospective studies, several studies have been conducted with the aim of testing the longitudinal link between metacognitive beliefs and anxiety pathology (e.g., Ramos-Cejudo & Salguero, 2017; Yılmaz et al., 2011). Prospective relationships have been identified between metacognitions and the following types of anxiety-related pathology: generalized anxiety (e.g., Thielsch et al., 2015), social anxiety (e.g., Nordahl et al., 2022; Nordahl & Wells, 2017), trait anxiety (e.g., Nordahl et al., 2019), health anxiety (e.g., Bailey & Wells, 2016), and obsessive-compulsive symptoms (e.g., Sica et al., 2007). In one such study, participants (N = 201 undergraduate students) completed a battery of self-report measures assessing metacognitive beliefs, depressive symptoms, and anxiety symptoms (Hjemdal et al., 2013). These measures were completed twice within a three-month time span. Hjemdal and colleagues found that

metacognitive beliefs were a significant predictor of future levels of anxiety, but not depressive symptoms. Similarly, adult participants (N = 105) in a prospective study completed a battery of questionnaires at two separate time points, six months apart (Bailey & Wells, 2016). Of a variety of cognitive and personality variables (e.g., illness attitudes, neuroticism, interpretation of bodily symptoms), maladaptive metacognitive beliefs were found to be the only independent significant predictor of health anxiety.

Regarding other types of anxiety disorders, Nordahl's research group conducted a series of studies in which they examined the relationship between metacognitive beliefs and other types of anxiety (e.g., social anxiety disorder [SAD] and trait anxiety). In the first study, Nordahl and colleagues (2017) examined change in negative cognitive- and negative metacognitive beliefs as independent correlates of symptom improvement in 46 SAD patients who were undergoing evidence-based treatments. The research group found that across 12 weeks, change in negative metacognitive beliefs was the only significant predictor across all four symptom outcomes (i.e., fear of negative evaluation, social anxiety, social interaction anxiety, and social avoidance and distress). In another study (Nordahl et al., 2019), this same research group found that at a cross-sectional level, metacognitive beliefs accounted for 83% of the variance in trait anxiety- and 64% of depression propensity. Prospectively, negative- and positive metacognitive beliefs were significant longitudinal predictors of a propensity for trait anxiety and depression. Most recently, Nordhal and colleagues (2022) conducted a study in which 868 participants completed an online 4-wave study across 24 weeks in which they examined the temporal relationship between metacognitive beliefs and social anxiety symptoms. The authors reported that metacognitive beliefs prospectively predicted social interaction anxiety, but that there was not a mutual relationship between the two constructs. The authors concluded that their findings suggested that

maladaptive metacognitive beliefs may be causally related to social interaction anxiety. Overall, these findings suggest that metacognitive beliefs, particularly negative metacognitive beliefs, are important in better understanding the development and maintenance of anxiety disorders.

The Cognitive Attentional Syndrome (CAS) and Anxiety

While work in this area is limited, a few studies have found evidence suggesting that CAS activation is associated with anxiety pathology (e.g., Fergus et al., 2012, 2013). For example, Fergus and colleagues (2012) assessed state anxiety symptoms and CAS activation in a large nonclinical sample (n = 456). The authors found that anxiety symptoms were significantly, positively associated with CAS activation (r = .49). In a later study, Fergus and colleagues (2013) examined CAS activation in a clinical sample presenting with either mood (i.e., depression) or anxiety (e.g., generalized anxiety, social anxiety, obsessive-compulsive, and panic) symptoms. The authors found that CAS activation was significantly associated with all of the assessed symptoms but were particularly relevant to depression and generalized anxiety symptoms. Additionally, one study conducted by Mohammadkhani et al. (2022) examined the mediating role of CAS activation in the relationship between maladaptive metacognitions related to health and COVID-19 anxiety. In this cross-sectional study, the findings revealed that not only were CAS activation and COVID-19 anxiety significantly associated, but CAS activation significantly mediated the relationship between metacognitions about health and COVID-19 anxiety. While researchers commonly rely on cross-sectional research designs, using cross-sectional research designs for the purpose of examining mediational effects is problematic as it prohibits researchers from being able to confirm that all conditions of causation have been met (i.e., temporal precedence). Moreover, these designs are more prone to biases within model

estimates (Maxwell et al., 2011; Maxwell & Cole, 2007). As such, it is important to utilize longitudinal study designs to identify causal relationships and test mediation.

Regarding existing prospective study designs, Nordhal and colleagues (in press) conducted a 4-wave study in which they assessed metacognitive beliefs, CAS activation (using a measure that combines metacognitive beliefs and CAS activation; Wells, 2011), and generalized anxiety in 868 adult participants. The authors examined intercorrelations among study variables and conducted two longitudinal mediation models (i.e., forward and reversed paths). First, the authors reported positive and significant intercorrelations between metacognition, CAS activation, and anxiety. Moreover, the authors found that CAS activation mediated the indirect effects in the relationship between metacognitive beliefs and anxiety across 24 weeks, while the reversed path (i.e., CAS activation mediating the relationship between anxiety and metacognitive beliefs) was nonsignificant. Nordhal and colleagues concluded that the results provide support for the metacognitive model and suggest that the CAS may in fact serve as a maintaining mechanism in the relationship between metacognitive beliefs and anxiety. While these findings provide important preliminary support for the metacognitive model, there are some notable limitations of this work that should be addressed in future research. Specifically, Nordhal and colleagues utilized a latent variable of metacognition as modeled by all five subscales of the MCQ-30, including positive and negative metacognitive beliefs, as manifest indicators. It will be important to examine the maintaining role of CAS activation on the relationship between maladaptive metacognitive beliefs using separate models for different types of maladaptive metacognitve beliefs. For example, among different types of maladaptive metacognitive beliefs, positive and negative metacognitive beliefs are thought to be particularly important for understanding the role that metacognitive beliefs play in activating the CAS and in the

development of anxiety (Wells, 1995, 2006). As such, it will be important to examine the distinct roles that these different types of metacognitive beliefs play in CAS activation and anxiety. Additionally, Nordhal and colleagues used the CAS-1 as the measure for CAS activation. While the CAS-1 has been found to have some adequate psychometric properties (Wells, 2011), recent work has reported a number of limitations of the CAS-1. For example, Conboy and colleagues (2021) identified several limitations including: redundant items, a number of items focused on metacognitive beliefs that are construct inconsistent, and a lack of CAS-related strategy specific subscales (e.g., substance use, worry, etc). These limitations have since been addressed in the development of the Multidimensional Cognitive Attentional Syndrome Scale (MCASS; Conboy et al., 2021). As such, it will be important in future research to utilize alternate measures of CAS activation such as the MCASS.

Taken together, the described findings provide a foundational understanding preliminary support for the metacognitive model. However, additional evidence is needed to support the primary assertion of the metacognitive model, that metacognitive beliefs activate the CAS, which leads to psychopathology (e.g., anxiety). Additionally, the lack of studies aimed at examining CAS activation and longitudinal work on the metacognitive model highlights the need for future work to better understand the temporal relationship between metacognitive beliefs and the CAS, as well as the impact these constructs have on anxiety symptoms.

To reiterate, the metacognitive model suggests that maladaptive metacognitive beliefs activate the CAS. Additionally, persistent engagement with the self-regulation strategies that make up the CAS is theorized to lead to the development and maintenance of psychopathology (e.g., anxiety). This model suggests that the CAS prolongs negative emotional states, strengthens maladaptive thoughts and perceptions, and prevents adaptive long-term learning. While an

abundance of evidence has suggested a link between metacognitive beliefs and anxiety pathology, very little research has examined the relationship between CAS activation and anxiety pathology. Moreover, no known investigation has examined the distinct roles that positive and negative metacognitive beliefs play in CAS activation and anxiety. As such, in the present study, I used a prospective study design to examine the mediating role of the CAS in the relationships between positive and negative metacognitive beliefs and anxiety. The first aim of the present study was to replicate previous findings (e.g., Fergus et al., 2012; Wells & Carter, 1999, 2001) and demonstrate significant cross-sectional associations between CAS activation, metacognitive beliefs (positive and negative), and anxiety. The second aim of the present study was to provide evidence supporting the metacognitive model, that is that CAS activation (assessed at Time 2 [T2]) will mediate the relationships between positive and negative metacognitive beliefs (assessed at Time 1 [T1]) and anxiety (assessed at Time 3 [T3]) across seven months.

Method

Participants

Participants included 573 adults recruited using Amazon's Mechanical Turk (MTurk). MTurk is an online crowdsourcing platform that provides adults with the opportunity to participate in research projects for financial compensation (Chandler & Shapiro, 2016). Past research has supported the use of MTurk samples, providing an abundance of evidence suggesting that MTurk consistently produces high-quality data (Behrend et al., 2011; Buhrmester et al., 2011; Chandler & Shapiro, 2016; Hauser & Schwarz, 2016; Paolacci et al., 2010; Shapiro et al., 2013). For example, when quality control procedures are utilized, MTurk data typically exhibits high internal consistency and retest reliability (Buhrmester et al., 2011; Schleider & Weisz, 2015; Shapiro et al., 2013). Compared to college student samples, MTurk samples have

been found to demonstrate better attentiveness (Hauser & Schwarz, 2016). Regarding generalizability, MTurk samples have been shown to be more demographically diverse than alternate convenience samples (e.g., student and community samples; Chandler & Shapiro, 2016). Further evidence has suggested that MTurk samples exhibit above average levels of psychopathology (e.g., anxiety and depressive symptoms; Arditte et al., 2016; Shapiro et al., 2013), making MTurk an optimal recruitment option for the present study.

Each MTurk worker is rated on their successful and reliable completion of "HITs" (i.e., human intelligence tasks). Past research utilizing MTurk samples has led to the recommendation of recruiting workers with at least a 95% approval rating to ensure the collection of high-quality data (Paolacci & Chandler, 2014; Peer et al., 2014). MTurk workers with at least a 95% approval rating provide better quality data than workers with lower ratings, even when these workers are approved with alternative quality control methods (e.g., catch questions; Paolacci & Chandler, 2014; Peer et al., 2014). As such, to ensure the quality of the data, participants in the present study had to have completed at least 50 MTurk tasks and received at least a 95% approval rating from past MTurk requesters.

Regarding additional quality control measures, with the influx of online research, online quality control recommendations include screening for possible "bot" workers (i.e., computer programs designed to automatically complete self-report forms online; Yarrish et al., 2019). In an effort to screen for these "bot" responses, all participants were required to complete text responses to open-ended questions in the present study. All responses at Time 1 were reviewed and coded as likely "bot" workers based on the relevance of the text response to the prompt. For all workers that were identified as likely "bots" at Time 1, these workers were excluded from the present analyses and were not invited to participate in future waves of data collection. In addition

to the previously described quality control measures, three catch questions (i.e., questions embedded within study measures to encourage attentive responding and identify participants who demonstrate patterns of inattention and a lack of effort when completing study measures) were included in the self-report battery presented to all participants. For example, "Please select 'Slightly agree' if you are paying attention right now." Consistent with the recruitment and exclusion methodology employed in other MTurk studies (e.g., Christenson & Glick, 2013), the majority (i.e., two out of three) of these questions were required to be answered correctly at T1 for a participant's data to be included in this study. Data that was not of adequate quality was excluded from the present analyses and these participants were not invited back for later waves of the study. After reviewing the collected data, 502 responders were identified as either bots or inattentive responders and were excluded from further analysis. Specifically, 323 responders did not complete all measures, 165 responders failed at least two of the three catch questions, and 14 responders were identified as bots.

Eligibility criteria for participants in the present study included a) being between the ages of 18-64, b) being fluent in English, and c) being located in the United States. The final sample (N = 573; 54.1% male) had an average age of 38.23 (SD = 10.92; *range* = 18 - 64) at the baseline assessment (T1). The majority of the sample reported their race as White (76.6%), followed by Black or African American (10.6%), Asian (10.1%), Other (1.4%), American Indian or Alaskan Native (1%), and Native Hawaiian or other Pacific Islander (0.2%). Additionally, 16.9% of the sample identified their ethnicity as Hispanic/Latino.

Self-Report Measures

The Depression and Anxiety Stress Scales – Anxiety Scale (DASS-21; Lovibond & Lovibond, 1995) was used in the present study to assess symptoms of anxiety. The DASS-21

Anxiety Scale includes seven items (e.g., "I felt scared without any good reason"), that are rated on a 4-point Likert scale (0 = *Did not apply to me at all* to 3 = *Applied to me very much, or most of the time*). Participants are instructed to rate each item based on the degree to which each item applied to them over the past week. Regarding psychometric properties, the DASS-21 has demonstrated adequate psychometric properties including construct validity and internal consistency (Antony et al., 1998; Lovibond & Lovibond, 1995). For example, Norton (2007) examined psychometric properties of the DASS-21 scales across four different racial and ethnic groups (i.e., African American, Caucasian, Hispanic, and Asian participants). Overall, Norton found that the DASS-21 Anxiety Scale demonstrated acceptable internal consistency across the entire sample ($\alpha = .78$) and within the four different racial and ethnic groups (αs ranging from .74 to .88). Moreover, past evidence has supported the use of the DASS-21 Anxiety Scale by demonstrating that individuals diagnosed with an anxiety disorder tend to score higher on this scale than nonclinical controls (Antony et al., 1998). Convergent validity has been established between the DASS-21 Anxiety Scale and other measures of anxiety such as the Beck Anxiety Inventory ($r = .81$; Lovibond & Lovibond, 1995). Similarly, Henry and Crawford (2005) reported evidencing good convergent validity between the DASS-21 Anxiety and the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) that replicate their results for the full version of the DASS (i.e., $r = .62$; Crawford & Henry, 2003). Importantly, test-retest reliability (i.e., measurement and structural invariance) for the DASS-21 was demonstrated across a three month period (Gomez et al., 2014). In the present study, the DASS-21 Anxiety Scale was presented to all participants at each of time point to assess level of participant anxiety symptoms. Internal consistency of the MCQ-30 in the current sample was excellent across all timepoints, and test-retest reliabilities were adequate across all data collection lags (see Table 1).

The Metacognitions Questionnaire-30 (MCQ; Wells & Cartwright-Hatton, 2004) is a 30-item self-report measure that was designed to assess domains of metacognitive beliefs. The MCQ-30 is composed of one total scale and five subscales, each assessing a different metacognitive belief domain. The domains (i.e., subscales) that were assessed in the present study include beliefs about the uncontrollability and dangerousness of thoughts or worries (i.e., negative metacognitive beliefs: "difficulty controlling what I think about means that I am going crazy") and beliefs about the benefits of worry and other maladaptive regulation strategies (i.e., positive metacognitive beliefs: "worrying helps me to avoid problems in the future"). MCQ-30 items are rated on 4-point Likert scale (1 = *do not agree* to 4 = *agree very much*). All participants were instructed to read each statement and indicate the degree to which they agree with that item. Higher scores are indicative of higher levels of metacognitive beliefs. The MCQ-30 has exhibited good psychometric properties, including internal consistency, retest reliability, construct validity, convergent validity, and measure invariance between men and women (Fergus & Bardeen, 2019; Spada et al., 2008; Wells & Cartwright-Hatton, 2004). For example, the MCQ-30 demonstrated adequate to acceptable internal consistencies for both the positive (αs = .77 to .83) and negative metacognitive belief scales (αs = .70 to .82; Wells & Cartwright-Hatton, 2004). Regarding the stability of the MCQ-30 scales, both the positive (r = .79) and negative metacognitive belief scales (r = .59) demonstrated acceptable to good test-retest validity over a range of 22 to 118 days (Wells & Cartwright-Hatton, 2004). Criterion-related validity of the positive and negative metacognitive belief scales is evidenced by positive correlations with measures of related constructs and psychopathology including worry (e.g., The Penn State Worry Questionnaire, rs = .29 to .73; Wells & Cartwright-Hatton, 2004) and trait anxiety (e.g., State-Trait Anxiety Inventory, rs = .28 to .69; Spielberger, 1983). In the present investigation, the

MCQ-30 negative metacognitive belief and positive metacognitive belief subscales were presented to all participants at each time point. Internal consistency of the MCQ-30 in the current sample was excellent across all timepoints, and test-retest reliabilities were adequate across all data collection lags (see Table 1).

The Multidimensional Cognitive Attentional Syndrome Scale (MCASS; Conboy et al., 2021) is a 21 item self-report measure that assesses activation of the seven domains of the CAS (i.e., worry, rumination, internal threat monitoring, external threat monitoring, thought suppression, physical avoidance behavior, and substance use). MCASS items are rated on a 6-point Likert scale (1 = *strongly disagree* to 6 = *strongly agree*). Each participant was instructed to read each statement and indicate the degree to which they generally agree with the item. Items on the MCASS are summed to create total and subscale scores. Higher total scores indicate greater overall CAS activation, while higher subscale scores indicate greater activation of the specific CAS strategy. While the MCASS is still a relatively new measure, Conboy and colleagues (2021) and Bardeen et al. (2022) have demonstrated that the MCASS has adequate psychometric properties including internal consistency and several validity indices (i.e., convergent, discriminant, and concurrent). Specifically, the MCASS total scale has demonstrated adequate internal consistency (α = .94; Bardeen et al., 2022). Convergent validity was evidenced by strong correlations (r = .82; Conboy et al., 2021) between the MCASS total scale and the only previously created self-report measure of the CAS (i.e., The Cognitive Attentional Syndrome-1; Wells, 2011). Criterion-related validity was established by examining correlations between the MCASS total scale score and other CAS-related constructs such as anxiety (i.e., DASS-21 Anxiety Scale, r = .69), depression (i.e., DASS-21 Depression Scale; r =.68), and metacognitive beliefs (i.e., total scale of the MCQ-30, r = .80; Conboy et al., 2021). As evidence of

discriminant validity, the MCASS total score held a small negative correlation with a measure of social desirability (Social Desirability Scale-17; r = -.17). Moreover, results from Bardeen et al. (2022) suggest that the MCASS is a multidimensional measure, consisting of a strong general factor and domain-specific factors that are sufficiently distinct. The MCASS total score was used at all three time points to assess CAS activation. Internal consistency of the MCASS in the current sample was excellent across all timepoints, and retest reliabilities were adequate across all data collection lags (see Table 1).

Procedure

The local institutional review board approved study procedures prior to data collection. At T1, a description of the proposed investigation, including an estimation of the study's duration and an explanation of its longitudinal nature, was provided for interested participants on the MTurk platform. At T1, participants provided informed consent electronically prior to the administration of study questionnaires and agreed to be invited to participate in later waves of data collection. All participants received an invitation to complete a battery of self-report measures online 3- and 6-months after completing T1 (Time 2 [T2]: 43.5% retention [n = 249] and Time 3 [T3]: 34.2% retention [n = 196)]). To protect participant confidentiality, all invitations were sent anonymously to the participants' MTurk accounts. All online sessions could be completed from any computer with internet access. Upon completion of each assessment session, participants were debriefed and provided with financial compensation that is consistent with previous studies of similar length (e.g., Fergus & Dolan, 2014; Michel et al., 2018). Specifically, all participants were compensated with $1.50 for T1, $1.75 for T2, and $2.00 for T3. As such, participants had the opportunity to earn $5.25 in total.

Study Design

Longitudinal data are crucial to investigations of mediational effects, but longitudinal investigations of these effects are remarkably rare within the existing psychological literature (Maxwell & Cole, 2007) and no known study has investigated the hypothesized effects of the present study. Past work has typically relied on cross-sectional research designs and analyses, which preclude researchers from being able to confirm that essential conditions of causation have been met (i.e., temporal precedence) and are inherently prone to biases within model estimates (Maxwell et al., 2011; Maxwell & Cole, 2007). Therefore, the present investigation utilized a cross-lagged panel model (CLPM), one of the primary research designs and analytical methods recommended for examining longitudinal mediation in psychological investigations (Preacher, 2015). The CLPM is based on structural equation modeling (SEM) for repeated measures. In this model, the predictor, proposed mediator, and outcome variables are all examined at each time point and allow the investigator to explore possible causal relationships across time (Preacher, 2015; Rovine & Liu, 2012). Given that a CLPM requires at least three waves of data collection (Preacher, 2015), this model assumes that causal inferences are strengthened by staggering the measurements of proposed predictors, mediators, and outcomes across "lags" in time.

When considering the length of time for each data collection lag, researchers have highlighted potential issues related to choosing inappropriate lag durations (i.e., either too short or too long; Cole & Maxwell, 2009; Oud, 2007). Given the scarcity of past research on the CAS, especially utilizing prospective study designs, we were unable to base the duration of time lags in the present study on prior research. Therefore, consideration of appropriate lag durations must come from other sources, such as the clinical literature on anxiety disorders. The diagnostic criteria of most anxiety disorders (e.g., generalized anxiety disorder, social anxiety disorder,

agoraphobia) specify that symptoms must be present for at least six months (APA, 2022). Therefore, lags in the current study were set at three months each to maximize the chances of capturing clinically significant changes in anxiety symptoms. This lag duration is consistent with other recent longitudinal studies of anxiety (e.g., Kim et al., 2022; Nechita & David, 2022). Data collection began in September of 2021 and was completed at the end of March in 2022 (7 months total for data collection).

Analytic Strategy

Analyses were conducted in both SPSS (version 28) and MPlus 8.4 (Muthén & Muthén, 2017). Missing data were handled using full information maximum likelihood (FIML), and models were estimated with a robust maximum likelihood (MLR) estimator. Two cross-lagged panel designs with three time-points each were used to examine the proposed mediation effect of 1) CAS activation between negative metacognitive beliefs and anxiety and 2) CAS activation between positive metacognitive beliefs and anxiety. The negative and positive metacognitive belief constructs were modeled using the negative metacognitive belief subscale and the positive metacognitive belief subscale scores of the MCQ-30 as indicators, respectively. Additionally, CAS activation was modeled using the total score of the MCASS serving as a manifest variable and anxiety symptoms were modeled using the DASS-21 anxiety subscale score as a manifest variable. Covariates (i.e., age, race/ethnicity, sex, attentive responding) were modeled as manifest variables. To account for effects specific to measurement occasion, manifest indicators were allowed to correlate within each time point. To examine the specificity of the temporal relationship among the variables, each of these models were estimated a second time with the paths modeled in the reverse direction.

Model fit was evaluated by way of four commonly recommended statistics (Hu & Bentler, 1999; Kline, 2015): the comparative fit index (CFI; good fit ≥ .95), the standardized root mean square residual (SRMR; good fit < .08), the root mean square error of approximation (RMSEA; good fit ≈ .05 and < .10), and the Tucker-Lewis index (TLI; good fit ≥ .95). In line with recommendations for assessing the significance of indirect effects (Hayes & Scharkow, 2013), bias-corrected bootstrapping was used to estimate the 95% confidence intervals around indirect effect parameters. Confidence intervals that did not include zero were considered indicative of a significant mediating effect. All parameter estimates that are reported are fully standardized (i.e., STDYX).

Sample Size Requirement

Estimating required sample sizes a priori is historically challenging for researchers working with SEMs (Gagne & Hancock, 2006). In a review of simulation studies considering appropriate sample sizes for a variety of SEMs, Hoyle and Gottfredson (2015) concluded that for SEM models of typical complexity, samples of at least 200 cases are needed to achieve desired levels of power. Additionally, attrition is a pervasive issue within longitudinal research. While no known estimate has been published on the overall attrition rate in longitudinal MTurk samples, investigators using these samples commonly report attrition rates of about 25% on average (e.g., Christenson & Glick, 2013; Daly & Nataraajan, 2015; Paas et al., 2018; Schleider & Weisz, 2015; Shapiro et al., 2013; Stoycheff, 2016; Wiens & Walker, 2015). Thus, the current study aimed to recruit 318 cases at each time point (three time points in total). The intention was that this total number of cases would account for longitudinal attrition (estimated at 25% per data collection lag). With a predicted total of approximately 600 observations, this sample was expected to afford adequate power (> .80), avoid biased parameter estimates, ensure solution

propriety, and improve the reliability of model fit indices (Gagne & Hancock, 2006; Hoyle & Gottfredson, 2015; Kim, 2005).

Retention rates at both T2 and T3 were less than expected (*n*s = 249 and 196, respectively). The poor retention rates across time points in the present study appeared to be primarily due to an abundance of participants who completed the survey at T1 but were not able to be contacted at subsequent time points (i.e., follow-up invitations were considered "undeliverable"). Specifically, 198 (34.55%) participants who had completed the study at T1 were unable to be contacted again with follow-up emails. All missing data were able to be handled through the use of modern missing data handling techniques (i.e., FILM; Enders & Bandalos, 2001). Robust maximum likelihood (MLR) estimation was used to test all models because it is robust to violations of the assumption of normality (Brown, 2015).

Results

Preliminary Analyses

Bivariate correlations were calculated in order to examine associations among demographic variables (i.e., age, race/ethnicity, sex, and status of attentive responding) and variables of interest (i.e., MCQ-30 Negative MCB subscale, MCQ-30 Positive MCB subscale, MCASS total score, and DASS Anxiety subscale score) for covariate inclusion. Regarding potential covariates, all demographic variables shared statistically significant correlations with the variables of interest for the present study. As such, age, race/ethnicity, sex, and status of attentive responding served as covariates in study analyses. See Table 1 for bivariate correlations between potential covariates and variables of interest. Moreover, internal consistency and test-retest reliability was assessed for all variables of interest to ensure the present study evidenced

adequate measurement reliability. See Table 1 for a summary of Cronbach Alphas and test-retest correlation coefficients for all variables of interest.

Primary Analyses

Correlation Coefficients

Hypothesis 1. The hypothesis that we would replicate positive associations among CAS activation, negative/positive metacognitive beliefs, and anxiety cross-sectionally was supported. CAS activation was significantly positively associated with negative metacognitive beliefs, positive metacognitive beliefs, and anxiety symptoms at Time 1, *r*s = .75, .69, and .67, respectively, *p*s < .001. Additionally, negative and positive metacognitive beliefs were significantly positively associated with anxiety at Time 1, *r*s = .77 and .72, respectively, *p*s < .001. See Table 1 for all intercorrelations between study variables.

Model 1. Negative metacognitive beliefs (N-MCB)

This model's RMSEA value, and the upper estimate of RMSEA 90% CI (RMSEA = .08 [90% CI = .06, .10]), CFI (.97), and SRMR (.06) were within recommended guidelines, but TLI (.89), failed to meet recommended guidelines. Given arguments for evaluating model fit continuously rather than as a dichotomous good/bad decision (Iacobucci, 2010), path estimates from the N-MCB model were evaluated, but with added caution. Refer to Figure 1 for a depiction of the N-MCB model. Hypothesis 2, that increased CAS activation at Time 2 would partially mediate the effect of negative metacognitive beliefs at T1 on increased anxiety at Time 3, was supported. Each variable predicted its subsequent measurements including negative metacognitive beliefs (βs .67 and .70, *p*s < 0.001), CAS activation (βs .59 and .63, *p*s < 0.001), and anxiety (βs .54 and .68, *p*s < 0.001). Significant effects were observed for the direct paths from (a) T1 MCB-N to T2 CAS (β = .18, p < .001) and (b) T2 CAS to T3 anxiety (β = .13, p =

.007). Importantly, T2 CAS partially mediated the relationship between T1 MCB-N and T3 anxiety (indirect effect = .02, p = .04).

Model 2. Negative metacognitive beliefs – Reversed paths (N-MCB-R)

To evaluate direction specificity, an additional model was examined in which the paths of model 1 were reversed. This model's RMSEA value, and the upper estimate of RMSEA 90% CI (RMSEA = .085 [90% CI = .07, .10]), CFI (.97), and SRMR (.07) were within recommended guidelines, but TLI (.87), failed to meet recommended guidelines. Given arguments for evaluating model fit continuously rather than as a dichotomous good/bad decision (Iacobucci, 2010), path estimates from the N-MCB-R model were evaluated, but with added caution. Refer to Figure 2 for a depiction of the N-MCB-R model. Each variable predicted its previous measurements including negative metacognitive beliefs (βs .54, ps < 0.001), CAS activation (βs .68 and .74, ps < 0.001), and anxiety (βs .58 and .77, ps < 0.001). Significant effects were observed for the direct paths from (a) T1 anxiety to T2 CAS (β = .11, p < .05) and (b) T2 CAS to T3 MCB-N (β = .15, p = .007). However, T2 CAS did not mediate the relationship between T1 anxiety and T3 MCB-N (indirect effect = .02, p = .13).

Model 3. Positive metacognitive beliefs (P-MCB)

This model's RMSEA value, and the upper estimate of RMSEA 90% CI (RMSEA = .05 [90% CI = .03, .07]), CFI (.99), TLI (.96), and SRMR (.04) were within recommended guidelines. Given that all fit statistics were within the recommended guidelines, path estimates from the P-MCB model were evaluated. Refer to Figure 3 for a depiction of the P-MCB model.

Hypothesis 3, that increased CAS activation at Time 2 would mediate the effect of positive metacognitive beliefs at T1 on increased anxiety at Time 3, was not supported. Each variable predicted its subsequent measurements including negative metacognitive beliefs (βs .70

and .88, *p*s < 0.001), CAS activation (*β*s .69 and .71, *p*s < 0.001), and anxiety (*β*s .49 and .71, *p*s < 0.001). Significant effects were observed for the direct paths from (a) T1 P-MCB to T2 CAS (*β* = .10, *p* < .05) and (b) T2 CAS to T3 anxiety symptoms (*β* = .14, *p* = .007). However, T2 CAS did not mediate the relationship between T1 P-MCB and T3 anxiety symptoms (indirect effect = .014, *p* = .096).

Model 4. Positive metacognitive beliefs – Reversed paths (P-MCB-R)

To evaluate direction specificity, an additional model was examined in which the paths of model 3 were reversed. This model's RMSEA value, and the upper estimate of RMSEA 90% CI (RMSEA = .07 [90% CI = .05, .08]), CFI (.98), and SRMR (.05) were within recommended guidelines, but TLI (.92), failed to meet recommended guidelines. Given arguments for evaluating model fit continuously rather than as a dichotomous good/bad decision (Iacobucci, 2010), path estimates from the P-MCB-R model were evaluated, but with added caution. Refer to Figure 4 for a depiction of the P-MCB-R model.

Each variable predicted its previous measurements including positive metacognitive beliefs (*β*s .59 and .79, *p*s < 0.001), CAS activation (*β*s .65 and .66, *p*s < 0.001), and anxiety (*β*s .62 and .82, *p*s < 0.001). Significant effects were observed for the direct path from (a) T1 anxiety to T2 CAS (*β* = .13, *p* < .05), but not for the direct path from (b) T2 CAS to T3 MCB-P (*β* = .017, *p* = .756). Moreover, T2 CAS did not mediate the relationship between T1 anxiety and T3 MCB-P (indirect effect = .002, *p* = .752).

Discussion

The present study is one of the first to provide support for the primary assertion of the metacognitive model of emotional disorders (i.e., metacognitive beliefs activate the CAS, which leads to psychopathology; Wells, 2011) and the first study to examine the distinct roles that

different types of metacognitive beliefs play in this relationship. A longitudinal study design was used to examine whether CAS activation mediated the relationship between metacognitive beliefs (i.e., positive and negative) and anxiety over the course of seven months. Initially, this investigation replicated past findings (e.g., Fergus et al., 2012; Wells & Carter, 1999, 2001) and evidenced significant, positive relationships among CAS activation, negative/positive metacognitive beliefs, and anxiety. Additionally, my secondary hypothesis was supported given that T2 CAS activation partially mediated the relationship between T1 negative metacognitive beliefs and T3 anxiety. In contrast, when this path was reversed, T2 CAS activation did not mediate the relationship between T1 anxiety and T3 metacognitive beliefs. Finally, my last hypothesis was not supported as CAS activation did not mediate the relationship between T1 positive metacognitive beliefs and T3 anxiety, nor did CAS activation mediate the relationship between T1 anxiety and T3 positive metacognitive beliefs.

Importantly, hypothesis two was supported as T2 CAS activation partially mediated the longitudinal relationship between T1 negative metacognitive beliefs and T3 anxiety. As readers will recall, the metacognitive model suggests that emotional disorders such as anxiety disorders develop as a result of metacognitive beliefs (e.g., positive and negative metacognitive beliefs; Wells, 2011). According to this model, metacognitive beliefs are theorized to activate and increase the habitual use of maladaptive self-regulation strategies (i.e., the CAS). The habitual engagement with the CAS over time is theorized to lead to the development and maintenance of anxiety pathology. This finding in the present study supports the model by suggesting that the CAS may serve as one possible maintaining mechanism in the relationship between negative metacognitive beliefs and anxiety. Given that the present results evidenced a partial mediation, this suggests that CAS activation accounts for some, but not all, of the relationship between

negative metacognitive beliefs and anxiety. Importantly, the longitudinal nature of the study design is important to consider when interpreting the present results. As there is a stark lack of longitudinal designs in the existing literature, most of the studies conducted so far have been unable to provide support for temporal precedence and thereby a causal relationship among these constructs. Therefore, the present findings help to provide evidence of temporal precendence for the relationship across negative metacognitive beliefs, CAS activation, and anxiety.

Notably, in model 2 (N-MCB-R), the paths in model 1 were reversed to determine if T2 CAS activation also mediated the relationship between T1 anxiety and T3 metacognitive beliefs. Study findings indicated that T2 CAS activation did not significantly mediate this relationship. These findings provide further support for the metacognitive model as it implies direction specificity of the relationship across negative metacognitive beliefs, CAS activation, and anxiety. That is, these results provide evidence for the specific temporal sequence that is proposed by the metacognitive model. (i.e., that metacognitive beliefs may in fact activate the cognitive attentional syndrome, which leads to the development and maintenance of anxiety pathology over time).

While the existing literature is sparse, the present findings are in line with published results so far. As the reader will recall, Mohammadkhani et al. (2022) found that in a cross-sectional study design, CAS activation mediated the relationship between health-related metacognitions and COVID-19 anxiety. While this study provides important preliminary findings that support the metacognitive model, cross-sectional studies that examine mediational effects obstructs the ability for researchers to confirm causation among study constructs as researchers can not establish temporal precedence. Regarding existing longitudinal studies, results of Nordhal and colleagues (in press), similarly found that metacognitive strategies

partially mediated the relationship between metacognitive beliefs and anxiety. Further, Nordhal and colleagues also examined the reversed longitudinal mediational model and found that there was no indirect effect of anxiety symptoms mediated by metacognitive strategies on metacognitive beliefs. Interestingly, the present findings replicated the partial mediational relationship that was identified in Nordhal and colleagues (in press). Overall, these findings suggest that there is consistent evidence for the primary assertion of the metacognitive model as it pertains to negative metacognitive beliefs. Specifically, individuals who are experiencing negative metacognitive beliefs are more likely to experience innocuous thoughts or images as signals indicating that something may be seriously wrong with them or that they are "going crazy." Having these negative metacognitive beliefs appear to, in part, increase the likelihood that the individual will continuously monitor their thoughts for signs that something is wrong with them, rather than acknowledging that these thoughts are transient and inconsequential. Ultimately, rigid and consistent engagement with CAS-strategies (e.g., worry, internal threat monitoring) appears to prolong emotional distress, eventually resulting in anxiety, and perhaps, related emotional disorders. Additionally, the individual perceives their original fears (e.g., "worrying will make me go crazy") as being confirmed when transient uncomfortable internal experiences (e.g., discrete emotions) turn into prolonged psychological distress.

Surprisingly, hypothesis 3 was not supported given that in model 3 (P-MCB), T2 CAS activation did not significantly mediate the relationship between T1 metacognitive beliefs and T3 anxiety. Additionally, in the reversed model (i.e., model 4 [P-MCB-R]), T2 CAS did not mediate the relationship between T1 anxiety and T3 positive metacognitive beliefs. These null results are surprising given the rationale of the metacognitive model, the existing preliminary data in the literature and the fact that hypothesis 2 of the present study was supported. As previously

discussed, the metacognitive model posits that because positive metacognitive beliefs highlight the benefits and value of engaging in CAS-related self-regulation strategies, these beliefs increase the likelihood that the individual will monitor for and notice distressing and intrusive cognitive events. When these cognitions are noticed, it is theorized that the individual maintains consistent engagement in avoidance-based CAS strategies as they believe that these strategies will help alleviate psychological distress and negative emotions. The metacognitive model posits that the engagement of these thoughts and strategies, which may be perceived as helpful in alleviating some distress in the moment, ultimately strengthens and maintains a pattern of psychological distress and habitual use of CAS strategies in the long-term.

Contrary to the present findings, the rationale proposed by the metacognitive model has received some support in the limited literature thus far. Specifically, positive metacognitive beliefs have consistently been found to be positively associated with anxiety (e.g., Gorday & Bardeen, 2022; Nordahl et al., 2019; Wong & Moulds, 2010). Moreover, Nordhal and colleagues (in press) reported positive associations among metacognitive beliefs, CAS activation, and anxiety. Nordhal found that metacognitive strategies (conceptualized as CAS actication) mediated the relationship between metacognitive beliefs and anxiety. Importantly, in those analyses the authors modeled the latent variable of metacognitive beliefs using all five subscales of the MCQ-30, including positive and negative metacognitive beliefs as manifest indicatiors. As such, the results from those analyses do not allow one to determine which maladaptive metacognitive beliefs are driving the relations among the variables of interest.

There are a few possible explanations for these null results. First, given that the current longitudinal design included the administration of the same measures at each of the three time points, the impact of autoregressive effects on the findings should be considered. Autoregressive

effects (i.e., the effect of a construct on a later assessment of the same construct; Selig & Little, 2012) tend to account for a large portion of the variance observed in longitudinal models. As a result, large autoregressive effects can obscure smaller, but potentially important longitudinal effects. As these effects may have impacted the P-MCB path model, it will be important to replicate the current study in larger samples, which would provide more power to detect small magnitude, significant effects. Additionally, the three-month time lags between study sessions may have been too short to detect increased anxiety as a result of positive metacognitive beliefs and subsequent CAS activation. No known study information exists on the duration of time needed for positive metacognitive beliefs to affect the CAS and contribute to anxiety. As previously mentioned, the 3-month lags used within this study were chosen based on the clinical literature surrounding anxiety disorders. Specifically, the diagnostic criteria of most anxiety disorders (e.g., generalized anxiety disorder, social anxiety disorder, agoraphobia) requires that symptoms must be present for at least six months (APA, 2022). Therefore, lag durations of three months were selected to maximize the chances of capturing clinically meaningful changes in this study's final outcomes, which was decided based on the recommendation of other researchers that the overall duration of the study (seven months) should span the interval of theoretical interest (Cole & Maxwell, 2003). Further, the selected time lags between study sessions was consistent with other recent longitudinal studies of anxiety (Kim et al., 2022; Nechita & David, 2022). However, despite this rationale, the lag durations in the present study may not have been optimized to capture the effect of positive metacognitive beliefs on anxiety, through CAS activation.

There is the possibility that these null results should be interpreted at face value and that positive metacognitive beliefs may not activate the use of CAS strategies and lead to the

development or exacerbation of anxious symptoms. Given that this study is the first and only known longitudinal investigation that examines the mediating role of the CAS on the relationship between positive metacognitive beliefs, in particular, and anxiety, the null results may suggest that positive metacognitive beliefs do not share the same role in activating the CAS as negative metacognitive beliefs. Past work has described negative metacognitive beliefs as the most important form of metacognition in the development and maintenance of psychological disorders because they lead the individual to perceive their own cognitions as a source of threat and increasing feelings of danger, hopelessness, and ineffectiveness (Huntley & Fisher, 2016).

Results from past studies have supported the notion that negative metacognitive beliefs may be of particular importance in the development of psychopathology (e.g., Ryum et al., 2017; Yılmaz et al., 2011). For example, Nordhal and colleagues (2018) assessed metacognitive beliefs in a cross-sectional study in which they recruited 102 patients diagnosed with SAD. The authors reported the results of a hierarchical multiple regression analysis they ran to test the additional contribution of metacognitive factors (i.e., the five types of metacogntive beliefs as assessed by the MCQ-30) in explaining variance in symptoms of depression. The results indicated that negative metacognitive beliefs emerged as the strongest predictor over and above the other predictors and explained 20.8% of the variance of depressive symptoms in SAD patients (Nordahl et al., 2018). Similarly Ramos-Cejudo and Salguero (2017) recruited 135 undergraduate students to complete self-report measures at two time points, three months apart. Ramos-Cejudo and Salguero conducted a series of hierarchical regressions to examine the moderating role of metacognitive beliefs on the relationship between baseline and time 2 levels of anxiety (i.e., cognitive and somatic symptoms of anxiety). Each hierarchical regression included one of the five types of metacognitive beliefs, as assessed using the MCQ-30. The

results evidenced significant interactions only for negative metacognitive beliefs, out of all the assessed metacognitons (Ramos-Cejudo & Salguero, 2017). Such results are in line with those evidenced by the present study and suggest that it may be that negative metacognitive beliefs are more important in activating the CAS, resulting in psychological distress.

Findings from the present study could have important implications for treatment, especially treatment options aimed at targeting negative metacognitive beliefs and CAS activation such as Metacognitive Therapy (MCT). MCT, a form of psychotherapy that is theoretically grounded in the metacognitive model, is based on the assumption that maladaptive metacognitive beliefs are important for understanding the pathogensis of psychopathology. According to Wells (2011), maladaptive metacognitions lead to a pattern of inflexible and recurrent styles of thinking that occurs when an individual experiences uncomfortable thoughts, emotions, and other internal experiences (Wells, 2011). In contrast to cognitive theory, metacognitive theory suggests that thought content, in and of itself, does not lead to psychopathology. Instead maladaptive metacognitive beliefs lead individuals to interpret uncomfortable internal experiences (e.g., thoughts, emotions, physical sensations) in a manner that increases the likelihood that they will engage in maladaptive CAS-related regulatory strategies that maintain and exacerbate emotional distress over time. As such, engrained maladative metacognitive beliefs (e.g., “worrying means that I am going crazy”), rather than transient distorted cognitions, as well as adaptive regulation strategies, are targeted in MCT. MCT is designed as a transdiagnostic treatment approach and is considered useful for a range of psychological disorders such as major depressive disorder, generalized anxiety disorder, posttraumatic stress disorder, and obsessive-compulsive disorder (Wells, 2011). Specifically, during MCT sessions flexible application of the manualized treatment is utilized to identify and

target metacognitive beliefs and CAS-related processes (Normann & Morina, 2018). One recent systematic review and meta-analysis conducted by Normann and Morina (2018) examined the efficacy of 25 MCT trials for a variety of psychological concerns (e.g., anxiety and depression). The authors concluded that MCT resulted in significantly higher symptom reduction on primary outcome measures as compared to alterate therapy options such as traditional cognitive behavioral therapy (CBT). Based on the present results, targeting negative metacognitive beliefs in particular may be of highest importance for clinicians who are training in and implementing MCT for individuals with anxiety disorders.

While MCT is considered a third wave form of CBT (Kahl et al., 2012), the results from the current study call attention to the possible benefits of targeting negative metacognitive beliefs and CAS activation rather than focusing primarily on altering thought content as is the primary target in second wave cognitive therapy. While the literature is limited, Newby and colleagues (2014) conducted a randomized controlled trial (RCT) to assess the impact of a transdiagnostic internet-delivered CBT program for mixed generalized anxiety disorder and major depressive disorder on negative repetitive thinking (RNT) and positive metacognitive beliefs about RNT. Although this RCT focused on positive metacognitive beliefs, the authors found that early reductions in these maladaptive metacognitive beliefs mediated improvements in anxiety and depression (Newby et al., 2014). Future studies and RCTs are needed to examine to the efficacy of targeting negative metacognitive beliefs and CAS-related strategies in the implementation of MCT and alterate psychotherapy options that focus on altering metacognitive beliefs and the CAS.

The current study is not without limitations. As the reader will recall, based on recommendations from the existing SEM literature, Hoyle and Gottfredson (2015) recommends

that for SEM models of typical complexity, samples of at least 200 cases are needed to achieve adequate levels of power. In addition to this recommendation, investigators who have conducted similar longitudinal samples have reported attrition rates of approximately 25% on average. Based on these two considerations, the present sample aimed to recruit enough participants to meet the threshold of 318 cases at each time point. While the final sample for T1 included 573 participants, due to poor attrition rates and exclusions based on inattentive response styles and possible bot responses, the final samples for T2 and T3 were 249 and 196, respectively. These time points may have had final sample sizes that were underpowered to detect small magnitude, but potentially important, cross-lagged effects. As such, future studies will benefit from the recruitment of larger samples at each time point. Additionally, the current study assessed anxiety using a brief self-report measure (i.e., the DASS-21 Anxiety subscale; Lovibond & Lovibond, 1995). Although the DASS-21 is a well established self-report measure of anxiety and past research has evidenced adequate psychometric properties, this measure does not assess for clinicially significant levels of anxiety symptoms or specific anxiety disorders. As such, the present findings may not generalize to the population with clinically significant levels of anxiety or specific forms of anxiety pathology. As such, future studies should recruit a clinical sample by utilizing diagnostic clinical thresholds as inclusion criteria and empirically validated structured clinical interviews (e.g., SCID-5; First et al., 2015).

The present study is the first to provide evidence that CAS activation mediates the longitudinal relationship between negative metacognitive beliefs and anxiety. Study findings highlight the importance of treatments that target negative metacognitive and CAS activation (i.e., MCT) in the reduction of anxious symptoms. Moreover, these findings highlight the need for continued work in better understanding the metacognitive model of emotional disorders.

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Appendix

Table 1

Observed Variable Intercorrelations & Psychometric Statistics

		1. MCQ-30 -Negative MCB	2. MCQ-30 -Positive MCB	3. MCASS	4. DASS -Anxiety	5. Age	6. Sex	7.Ethnicity/ Race	8. Attentive responding
Time 1	1.	.91							
	2.	.73**	.93						
	3.	.74**	.69**	.95					
	4.	.77**	.72**	.67**	.94				
	5.	-.22**	-.21**	-.20**	-.20**	--			
	6.	.09*	.11**	-.00	.13**	-.02	--		
	7.	.12**	.15**	.08	.13**	-.12**	.11**	--	
	8.	-.60**	-.65**	-.47**	-.74**	.16**	-.20**	-.13**	--
	Means	13.18	13.04	78.85	06.87	38.23	1.54	1.33	2.54
	(*SDs*)	(*05.15*)	(*05.28*)	(*22.10*)	(*06.26*)	*(10.92)*	*(0.50)*	*(0.47)*	*(0.50)*
Time 2	1.	.93							
	2.	.61**	.95						
	3.	.74**	.65**	.94					
	4.	.68**	.59**	.63**	.95				
	5.	-.14*	-.13*	-.07	-.06	--			
	6.	-.09	.00	-.16*	.01	-.02	--		
	7.	.02	.07	.02	.04	-.12**	.11**	--	
	8.	-.42**	-.48**	-.37**	-.68**	.16**	-.20**	-.13**	--
	Means	11.38	11.31	71.97	03.78	--	--	--	--
	(*SDs*)	(*05.25*)	(*05.11*)	(*22.23*)	(*05.26*)	--	--	--	--
Time 3	1.	.91							
	2.	.60**	.96						
	3.	.69**	.57**	.94					
	4.	.71**	.48**	.57**	.93				
	5.	-.18*	-.18*	-.16*	-.14	--			
	6.	-.08	.05	-.15*	.05	-.02	--		
	7.	-.01	.08	.02	-.04	-.12**	.11**	--	
	8.	-.37**	-.32**	-.25**	-.48**	.17**	.20**	-.13**	--
	Means	10.49	10.75	71.04	03.07	--	--	--	--
	(*SDs*)	(*04.69*)	(*05.03*)	(*22.32*)	(*4.60*)	--	--	--	--

Test-retest	T1-T2 *r*s	.74	.75	.78	.79	--	--	--	--
	T2-T3 *r*s	.78	.81	.76	.77	--	--	--	--
	T1-T3 *r*s	.66	.71	.66	.68	--	--	--	--

Note. Cronbach's αs displayed on the diagonal; ** correlation is significant at $p < .001$; * correlation is significant at $p < .05$; *n*s for Time 1, Time 2, and Time 3 were 573, 249, and 196, respectively.

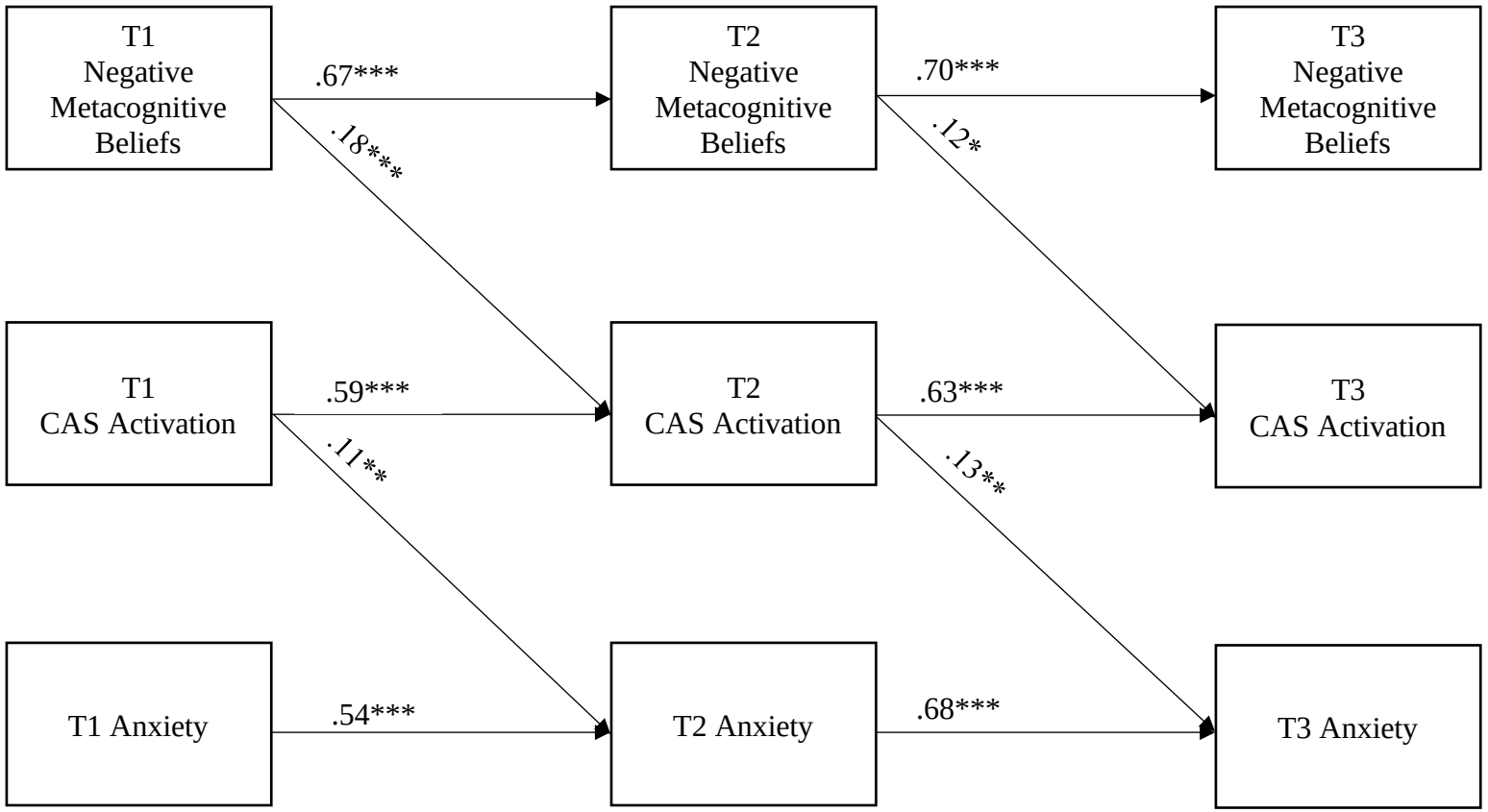

Figure 1. Model 1. N-MCB Path model with standardized path coefficients, *p <.05. **p <.01. ***p < 001.

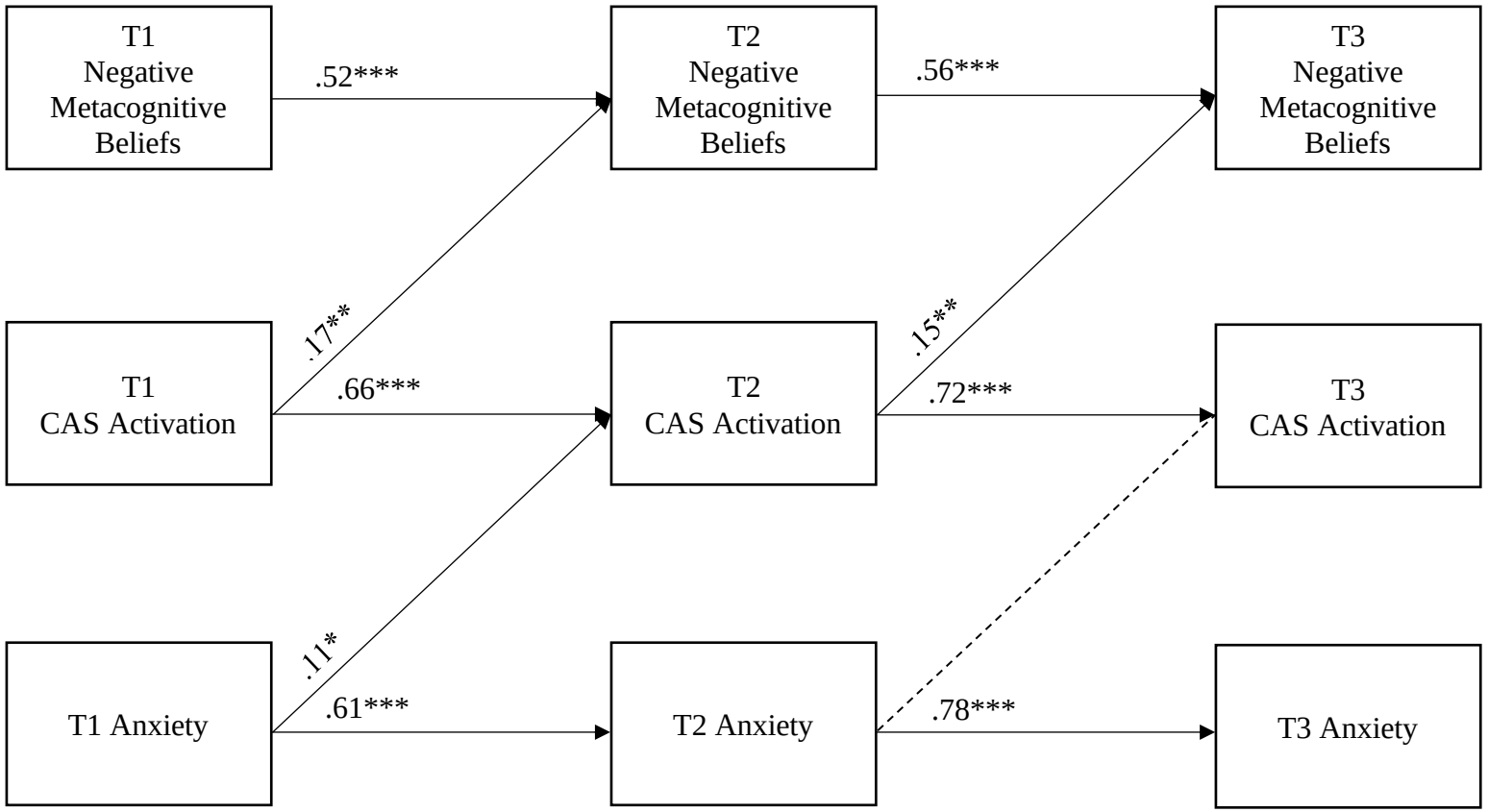

Figure 2. Model 2. N-MCB-R Path model with standardized path coefficients, *p <.05. **p <.01. ***p < 001. Dashed lines indicate paths with nonsignificant coefficients.

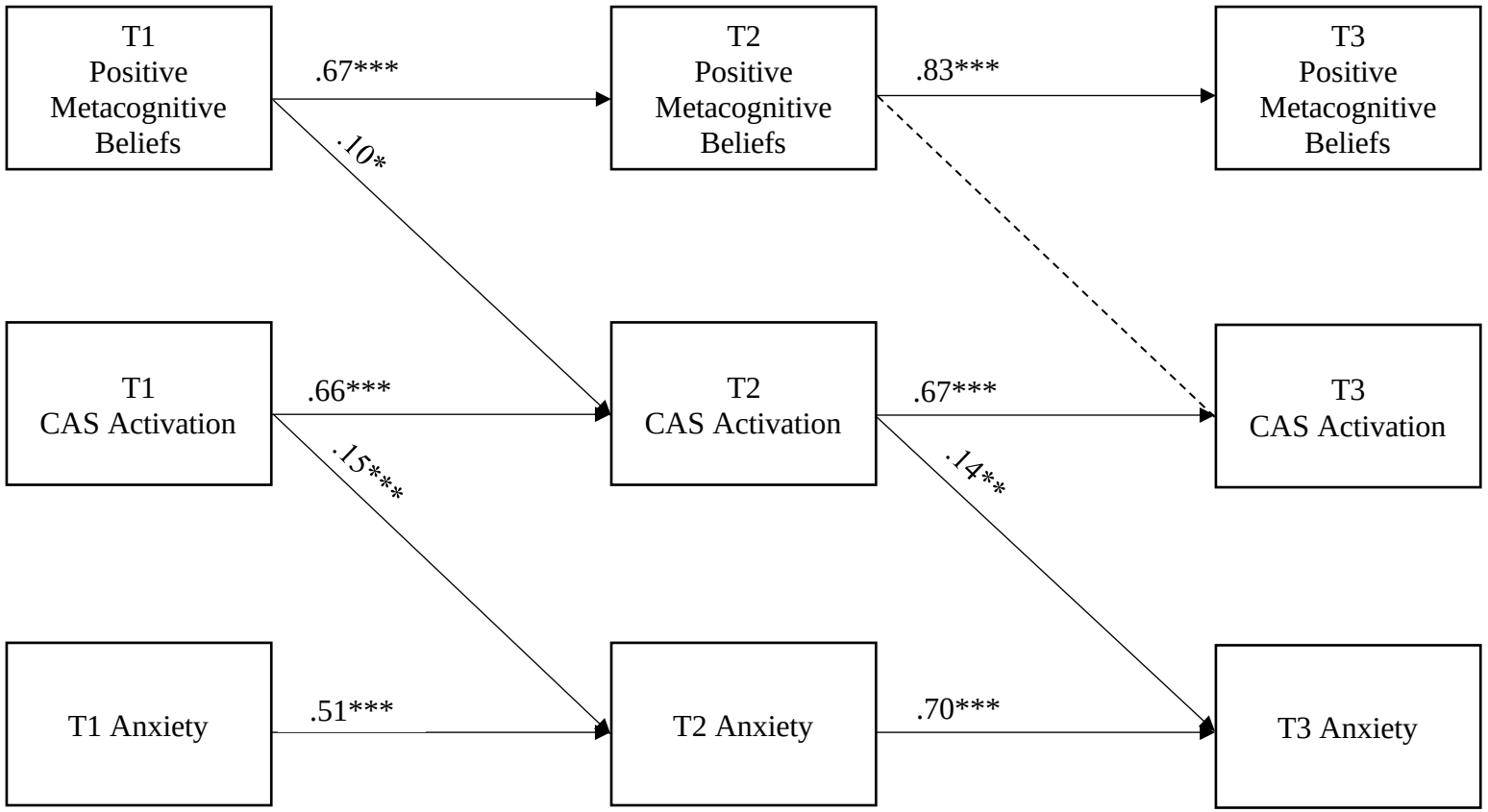

Figure 3. Model 3. P-MCB Path model with standardized path coefficients, *p <.05. **p <.01. ***p < 001. Dashed lines indicate paths with nonsignificant coefficients.

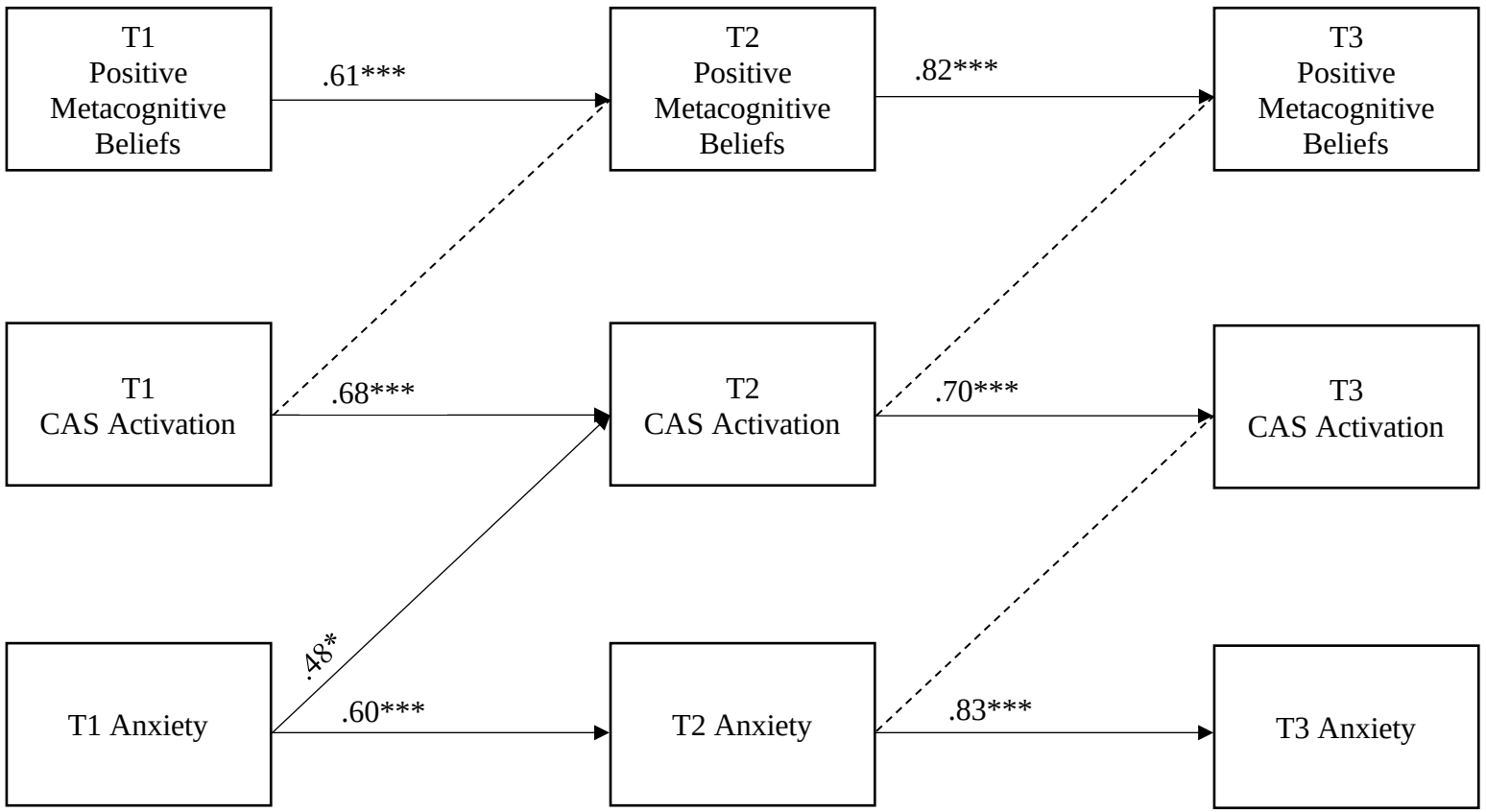

Figure 4. Model 4. P-MCB-R Path model with standardized path coefficients, *p <.05. ***p < 001. Dashed lines indicate paths with nonsignificant coefficients.