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*Boston University*

BOSTON UNIVERSITY  
GRADUATE SCHOOL OF ARTS AND SCIENCES

Dissertation

**DECISION-MAKING IMPAIRMENT IN EMOTIONAL DISORDERS**

by

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# **DECISION-MAKING IMPAIRMENT IN EMOTIONAL DISORDERS**

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## **ABSTRACT**

Decision-making has become the focus of increased scientific attention in recent years. Attempts to characterize decision-making deficits in unipolar mood and anxiety disorders have, however, produced conflicting results. The current study examined two types of impairment, indecisiveness and risky decision-making, in a clinical sample of individuals with depression and/or anxiety. Depression and obsessive-compulsive disorder (OCD) symptoms were hypothesized to predict both self-reported indecisiveness and decision latency on behavioral tasks, with processing speed partially mediating the relationship between psychopathology and decision latency. It was hypothesized that symptoms of OCD and generalized anxiety disorder (GAD) would predict advantageous performance on a task assessing risky decision-making, and that executive functioning would partially mediate the relationship between psychopathology and risky decision-making.

A sample of individuals ( $N = 74$ ) who had recently undergone semi-structured diagnostic interviews was recruited for the current study. All participants were diagnosed with at least one unipolar mood or anxiety disorder, with the majority meeting criteria for two or more disorders. All participants completed the same study protocol, which

included self-report measures, neuropsychological tests, and computer-administered decision-making tasks. Regression analyses and latent growth modeling were used to examine associations between psychopathology, decision-making, and neuropsychological variables.

Self-reported depressive symptoms and OCD symptoms predicted self-reported indecisiveness. Contrary to prediction, psychopathology (when measured dimensionally via self-report measures or operationalized as the presence or absence of a depressive disorder, GAD, or OCD) did not predict decision latency, and there was no evidence of a mediating effect of processing speed. Self-reported depressive symptoms, but not self-reported symptoms of GAD or OCD, were positively associated with ratings of decision difficulty. On a measure of risky decision-making, a diagnosis of GAD and poorer set-shifting were both associated with less improvement in performance over the course of the task, whereas a diagnosis of OCD was associated with more improvement.

Results are discussed in the context of the decision-making literature. Methodological challenges to the study of decision-making are addressed and ideas for future research are proposed.

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## List of Abbreviations

ACC	Anterior cingulate cortex
ADIS-IV	Anxiety Disorders Interview Schedule for <i>DSM-IV</i>
ADHD	Attention-Deficit Hyperactivity Disorder
BART	Balloon Analogue Risk Task
BDI-II	Beck Depression Inventory-II
BIS-11	Barratt Impulsiveness Scale
CARD	Center for Anxiety and Related Disorders
CSR	Clinical Severity Rating
DASS-21	Depression Anxiety Stress Scales (21-item version)
DSM	<i>Diagnostic and Statistical Manual of Mental Disorders</i>
GAD	Generalized Anxiety Disorder
IGT	Iowa Gambling Task
IS	Indecisiveness Scale
LGM	Latent Growth Model(ing)
MDD	Major Depressive Disorder
NOS	Not Otherwise Specified
OCD	Obsessive-Compulsive Disorder
OCI-R	Obsessive-Compulsive Inventory—Revised
PFC	Prefrontal Cortex
PSWQ	Penn State Worry Questionnaire

PST	Problem-Solving Training
PTSD	Posttraumatic Stress Disorder
SOC	Stockings of Cambridge
SSS	Subjective Symptoms Scale
VM	Ventromedial Prefrontal Cortex
WAIS-III	Wechsler Adult Intelligence Scales—III

## Introduction

Over the past 20 years, decision-making has become the focus of increased scientific attention, with researchers in a variety of fields attempting to characterize how individuals make decisions (e.g., Bechara, Damasio, Damasio, & Anderson, 1994; Frost & Shows, 1993; Luce, Bettman, & Payne, 1997; Murphy et al., 2001; Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003). Theories of decision-making that emphasize the role of emotion have supplanted traditional “rational choice” paradigms, and dysfunctions in decision-making processes have been identified in multiple forms of psychopathology (Paulus, 2007; Rahman, Sahakian, Cardinal, Rogers, & Robbins, 2001). Much of the research on decision-making impairment has focused on neurologic or psychiatric disorders characterized by marked impulsivity, with less attention paid to decision-making in individuals with unipolar mood and anxiety disorders.

The aims of this study were to characterize decision-making deficits associated with anxiety and mood disorders, determine if particular disorders uniquely predict decision-making dysfunction, and examine the relationship between these deficits and cognitive functioning.

### Overview of Decision Science

The dearth of literature on decision-making impairment in unipolar depression and anxiety disorders may be due, in part, to the absence of a standard definition of decision-making itself. In colloquial use, the term is often used interchangeably with *judgment* and *choice*. Traditionally, researchers have used the term *judgment* to describe the evaluation of options and *decision-making* to refer to the selection of a course of

action (Hastie, 2001). Others, however, define *decision-making* broadly to include the appraisal of available options, execution of a choice, and evaluation of the outcome (Paulus, Feinstein, Simmons, & Stein, 2004). The term has been used to describe everything from simple sensory discriminations (Heekeren, Marrett, & Ungerleider, 2008) to complex evaluations of social justice and economic self-interest (Rilling & Sanfey, 2011).

**Measuring decision-making.** Not surprisingly, tasks designed to assess decision-making vary widely across studies, reflecting the imprecision of the term and the fragmented nature of the decision-making literature. Researchers representing numerous fields—including anthropology, economics, neuroscience, and psychiatry—have contributed to the literature on decision-making, leading to the development of myriad decision-making tasks, some of which bear little resemblance to one another (e.g., Lejuez et al., 2002; Sanfey et al., 2003). Currently, the most widely used and standardized tasks to assess decision-making in the context of psychopathology are computer-administered simulations of gambling decisions (e.g., Bechara, Damasio, Tranel, & Damasio, 1997; Rogers et al., 1999). Other approaches have included the use of “information boards” on which experimenters display a matrix describing attributes of each option (Ferrari & Dovidio, 2001); a task requiring respondents to choose a hypothetical romantic partner after reading a series of vignettes (Forgas, 1991); and a battery of tasks assessing individuals’ application of traditional decision rules (Bruine de Bruin, Parker, & Fischhoff, 2007). Unfortunately, there have been few attempts to evaluate the convergent

or external validity of laboratory decision-making tasks (Bishara et al., 2009; Monterosso, Ehrman, Napier, & O'Brien, 2001).

As the definition and measurement of decision-making have evolved, so has researchers' definition of competent decision-making. Traditional theories of decision-making were based on economic models and assumed that the "ideal" decision maker's thought processes were free of biases and heuristics (Edwards, 1961). These early theories of decision-making may be classified as descriptive or prescriptive, either describing normative decision processes or providing a set of rules for combining probabilities and utilities for selecting an option (Pitz & Sachs, 1984). "Good" decisions were those that demonstrated internal coherence and logical consistency within a system of beliefs. These rational choice paradigms, which typically assumed the existence of a correct response to a decision task (Mellers, Schwartz, & Cooke, 1998), remain influential (e.g., Bruine de Bruin et al., 2007; Parker & Fischhoff, 2005), most notably in the assessment of decision-making capacity in cognitively impaired elderly adults (e.g., Kim, Karlawish, & Caine, 2002).

More recent theories, however, have acknowledged that an error in a traditional decision-making task may constitute an adaptive decision in another setting, and that decision makers are influenced by factors other than the expected utility of a decision (Mellers et al., 1998). Researchers have demonstrated that normal decision-making is characterized by significant, and often predictable, departures from rationality (Tversky & Kahneman, 1974) and that environmental variables may significantly affect the choices people make (Payne, 1982).

The role of emotion in decision-making was not systematically studied until the 1980s and 90s, when investigators began to consider the influence of pre- and post-decision affect on decision-making (Estrada, Isen, & Young, 1994; Isen & Means, 1983). In the mid-1990s and 2000s, the study of decision-making became the domain of affective neuroscience, with researchers considering the effect of focal brain lesions on decision-making (Bechara, Tranel, & Damasio, 2000; Naqvi, Shiv, & Bechara, 2006). The burgeoning field of decision science now includes the study of various patient groups and attempts to link clinical syndromes to performance on laboratory tasks of decision-making.

### **Decision-Making's Relevance to Psychopathology**

Clinicians and researchers have long recognized that individuals with certain neurologic conditions may exhibit impaired real-life decision-making (e.g., Bechara, Damasio, Tranel, & Damasio, 2005; Fellows, 2006). Increasingly, researchers have attempted to apply laboratory findings from neurologic samples to individuals with mental disorders, and to elucidate how psychopathology may lead to disadvantageous decision-making. Although the clinical signs and symptoms of emotional disorders are substantially different from those of frontal lobe damage, certain features of anxiety and unipolar depression suggest that these disorders may be associated with decision-making deficits. Depressed individuals, for example, exhibit decreased responsiveness to reward (Eshel & Roiser, 2010), which may lead to a reduction in adaptive, approach-related behaviors. Furthermore, schemas associated with depression include beliefs about one's helplessness and incompetence, as well excessively high standards for personal

performance and excessive attention to detail (Young, Weinberger, & Beck, 2001). Characterized by exaggerated perceptions of risk (Butler & Mathews, 1987), fear of making mistakes (Antony, Purdon, Huta, & Swinson, 1998), and excessive doubting (Aardema & O'Connor, 2012; Bechara et al., 2001), anxiety may result in inaction or a pathological degree of risk aversion. Both anxiety and unipolar depression involve altered perceptions of risk or reward and biases that may lead to distress during decision-making, as well as prolonged decision times. As such, the current study focuses on two types of decision-making pathology, decision-making under risk and indecisiveness.

**Decision-making under risk.** In an attempt to explain the real-life decision-making impairments of patients with damage to the ventromedial prefrontal cortex (VM), Damasio (1994) proposed the somatic marker hypothesis. According to this theory, emotions are not merely the byproduct of decisions; rather, they provide information with which people make decisions. Emotions, represented as somatic states, or the body's "internal milieu" (Bechara, Damasio, & Damasio, 2000; p. 295), operate as alarms or incentive signals when individuals make decisions. The VM is thought to provide the substrate for learning associations between particular situations and emotional states. Impulsive behavior observed in patients with damage to the VM is believed to result from disruption in the normal processing of emotional signals. Unlike healthy control participants, patients with damage to the VM fail to respond to nonconscious, somatic signals that are suggestive of environmental threat or risk (Bechara et al., 1997).

The Iowa Gambling Task (IGT; Bechara et al., 1994) was developed to test some of the central tenets of the somatic marker hypothesis in patients with neurologic and

psychiatric disorders. Designed to simulate real-life decisions in the context of uncertainty and risk, the IGT is a computer-administered task during which participants are instructed to make money by drawing cards from one of four decks, with each card conferring an immediate reward or penalty. Two of the decks contain high-reward/high-punishment cards and two decks contain low-reward/low-punishment cards. Participants are not informed of the length of the game or the frequency with which they will incur losses. Bechara et al. (1997) have demonstrated that control participants, presumably anticipating the potential consequences of their choice, experience a marked galvanic skin response prior to drawing from a high-risk deck, though patients with VM damage do not. Control participants typically choose fewer high-risk cards and incur fewer large losses than patients, whose impaired performance purportedly results from their inability to consider the future consequences of their decisions when faced with the possibility of immediate reward. The somatic marker hypothesis has proven helpful in explaining the impulsive decision-making observed in patients with frontal lobe damage, but its suitability to the study of unipolar mood and anxiety disorders remains unclear (Dunn et al., 2006). The IGT has inspired the development of other computer-administered measures of risky decision making. Unlike the IGT, the Rogers Decision-Making Task (1999) offers respondents unambiguous information about the risk and reward associated with each choice, rather than requiring them to learn these contingencies through trial and error. The Balloon Analogue Risk Task (BART) requires participants to inflate a simulated balloon; each “pump” causes the balloon to grow and results in the accrual of “money” until, at a predetermined point, risk-taking becomes disadvantageous, the

balloon explodes, and the participant loses all of his or her earnings. Although both the Rogers task and the BART purport to correct weaknesses in the IGT (addressed further in the Discussion), the IGT remains the most widely used laboratory task of decision-making.

**Indecisiveness.** Despite receiving relatively little attention in the empirical literature, indecisiveness has been implicated in several anxiety and mood disorders. Since the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM; APA, 1980), indecisiveness or “difficulty making decisions” has been included in the diagnostic criteria for major depressive disorder (MDD) and dysthymic disorder. Although not part of the formal definition of obsessive-compulsive disorder (OCD), indecisiveness has long been considered a feature of the disorder (Milner et al., 1971; Reed, 1976). Nevertheless, there is little empirical evidence of an association between emotional disorders and indecisiveness. Twenty years after Frost and Shows (1993) noted that “almost all the work on indecisiveness has been theoretical or descriptive” (p. 683), the literature on indecisiveness and its relationship to psychopathology remains limited.

Frost and Shows (1993) have characterized indecisiveness as a multidimensional construct consisting of uncertainty about preferences, difficulty organizing one’s actions, decision postponement, and pre- and post-decision anxiety. Their use of the term “compulsive indecisiveness” suggests a relationship between indecisiveness and OCD, but they offer little speculation about the construct’s relationship to psychopathology (i.e., is it an associated feature of OCD or a trait that waxes and wanes in the presence of psychopathology?). Within vocational psychology and career counseling, *indecisiveness*

is frequently described as a maladaptive personality trait and *indecision* as a normal developmental phase (Holland & Holland, 1977; Taylor & Betz, 1993). This distinction, however, does not appear to be widely adopted outside the field of vocational counseling, with many researchers using the terms *indecisiveness* and *indecision* interchangeably. The study of indecisiveness has been limited by the absence of a widely accepted definition of the term, validated self-report and behavioral measures, and a coherent model of its relationship to psychopathology. Furthermore, research on indecisiveness is also complicated by its conceptual overlap with related constructs such as decision avoidance (Anderson, 2003), procrastination (Ferrari & McCown, 1994), and experiential avoidance (Hayes et al., 1996).

Much of our knowledge of indecisiveness and its behavioral correlates comes from studies of nonclinical samples. Self-reported indecisiveness has been associated with prolonged information searches (Rassin, 2007; Rassin & Muris, 2005), greater preference for “I don’t know” responses on a questionnaire requiring judgments of ambiguous situations (Rassin et al., 2007; Rassin & Muris, 2005), less confidence in decisions (Gaff, Krausz, & Osipow, 1996), and greater difficulty choosing undergraduate majors and career paths (Gaff et al., 1996; Gayton et al., 1994). Self-reported indecisiveness is highly correlated with measures of depression, worry, and obsessive-compulsive symptoms in nonclinical samples (Frost & Shows, 1993; Rassin et al., 2006), underscoring the importance of studying the construct in individuals with anxiety and mood disorders.

Despite a proliferation of decision-making research over the past 15 years, the relationship between decision-making and psychopathology, particularly anxiety and unipolar mood disorders, remains uncertain. Clearly, one challenge to decision science is that decision-making is likely composed of multiple cognitive processes. As such, one could define dysfunctional decision-making in multiple ways: making decisions too slowly or impulsively; making decisions likely to result in negative outcomes; or experiencing significant distress during the decision-making process. The current study draws from two lines of inquiry in decision science: one, informed by affective neuroscience and neuropsychology, that investigates the association between psychopathology and risky decision-making, and another that has focused on the affective and behavioral correlates of indecisiveness. These lines of research have remained largely separate, perhaps reflecting the disparate theories and models that have guided research in the field.

### **Models of Decision-Making Impairment**

Multiple models of have been proposed to account for decision-making impairments observed in psychiatric and neurologic populations. Some of these are disorder-specific (e.g., Sachdev & Malhi, 2005), whereas others attempt to explain decision-making abnormalities across a range of populations (e.g., Bechara, Damasio, & Damasio, 2000; Paulus, 2007). Below we review some of the most relevant to understanding decision-making in patients with anxiety and mood disorders.

Perhaps the most the widely cited model of impaired decision-making is Damasio's (1994) somatic marker hypothesis, the basic tenets of which were described

above. According to this model, individuals with VM damage and certain psychiatric disorders either fail to generate measurable somatic responses when contemplating decisions or fail to attend to them. Consequently, they lack important information on which to base their choices. Bechara, Damasio, et al. (2000) have suggested that the somatic marker hypothesis may be applicable to a range of psychiatric disorders (e.g., alcohol/substance use, schizophrenia, attention-deficit hyperactivity disorder, depression). However, studies of patients with unipolar mood and anxiety disorders have produced mixed results on the IGT and similar gambling tasks (Jollant et al., 2005; Must et al., 2006; Paulus, 2007). Furthermore, it remains unclear if the proposed neuroanatomical mechanism behind the somatic marker hypothesis (i.e., disruption in the processing of emotional signals in the VM) is, in fact, relevant to the study of patients with unipolar mood and anxiety disorders.

Like the somatic marker hypothesis, Paulus's (2007) transdiagnostic model of decision-making impairment presumes that interoceptive valuation of options guides decision-making. This model proposes, however, that decision-making dysfunction in psychiatric populations results from dysregulation of homeostatic balance. Dysfunction in phases of the decision-making process—including misevaluation of options, suboptimal choices, and inaccurate evaluation of outcomes—are presumed to result from maladaptive efforts to achieve homeostasis. Paulus (2005, 2007) proposes that altered decision-making in depression results from dysfunctions in reward processing (and concomitant decreased interest in or pleasure from participation in activities), whereas dysfunction in anxiety disorders results from increased sensitivity to aversive outcomes.

According to this model, a variety of brain regions may underlie decision-making deficits, with decreased ventral striatal activation implicated in depression, and increased activation in the anterior cingulate cortex (ACC) and medial prefrontal cortex (PFC) implicated in anxiety disorders. Nevertheless, Paulus and Yu (2012) noted that researchers have yet to link specific anxiety or mood states or disorders to decision-making dysfunction.

Other researchers have advanced disorder-specific models of decision-making impairment. For example, Sachdev and Malhi (2005) have argued that OCD is fundamentally a disorder of decision-making, resulting from decisions acquiring an abnormal emotional valence due to over-activity in the orbitofrontal cortex. The authors propose that decision-making becomes associated with increased negative affect, resulting in abnormal activation of the ACC and prolonged decision-making efforts. Empirical support for this model is limited, with several studies failing to detect any decision-making abnormalities among non-hoarding individuals with OCD (Lawrence et al., 2006; Milner et al., 1971; Starcke et al., 2010). Nevertheless, it is notable given the long association between OCD and indecisiveness in the clinical and research literature (e.g., Milner et al., 1971).

Models to account for indecisiveness have typically appeared outside of the neuroscience literature. Anderson (2003) has proposed a model of decision avoidance that describes the antecedents (e.g., anticipated regret, costs of action and change) and consequences (e.g., regret, fear regulation) of postponing decisions. Rassin (2007) attempted to integrate previous research on indecisiveness into a coherent model that

offers a precise definition of the construct and describes its corresponding behaviors. In this model, “indecisives” are distinguishable from “decisives” by their tendencies to (1) delay decisions, (2) experience decisional “tunnel vision” (i.e., seeking out more information about their eventual choice, but less information about non-chosen options), and (3) display dysfunctional post-decision behavior (e.g., worrying, checking, reconsideration of decisions). Although useful in specifying some of the behaviors associated with indecisiveness, neither model explicitly addresses the relationship between psychopathology and indecisiveness. Unfortunately, there is substantial variation in how indecisiveness has been defined and operationalized, with over 20 definitions appearing across literatures (Potworowski, 2010). Indecisiveness has variously been described as a trait, a behavior (e.g., prolonged decision latency), and an emotional state (e.g., distress about the decision-making process), undermining attempts to establish its relationship with theoretically related constructs.

Janis and Mann (1977) offered one of the few models of decision-making impairment that is closely linked to a psychological intervention. Their conflict theory model proposes that decisional conflict arises when an individual obtains information that threatens his or her current state of mind, resulting in uncertainty, apprehension, and dysfunctional coping behaviors (e.g., making poor choices, avoiding decisions). Janis and Mann identified two sources of stress arising from decisional conflict: (1) concern about material and social losses as a result of a particular decision and (2) apprehension about losing one’s reputation or self-perception as a competent decision maker. Decisional conflict, they argued, typically results in five distinct patterns of coping: (1) *unconflicted*

*adherence*, in which the decision maker continues what he or she has been doing and ignores risks, (2) *unconflicted change to a new course of action*, in which the decision maker adopts a new course of action without critically evaluating it, (3) *defensive avoidance*, in which the decision maker engages in procrastination or shifts decision-making responsibility to someone else, (4) *hypervigilance*, in which the highly anxious decision-maker impulsively chooses an alternative that may provide immediate relief, without adequately considering its long-term consequences, and (5) *vigilance*, in which the individual makes an effort to seek out all relevant information and considers it carefully before making a choice. Noting that defensive avoidance is perhaps the most commonly observed response to difficult decisions, Janis and Mann (1977) proposed a variety of strategies to assist the decision maker, including role-playing, creation of a decisional balance sheet, and stress inoculation training for post-decision setbacks. Although some parts of Janis and Mann's (1977) theory are broadly consistent with idea that anxiety leads to behavioral avoidance (e.g., Hayes et al., 1996), neither their theory nor counseling approach has been formally tested.

In summary, multiple models of decision-making impairment have appeared in the literature, but few have generated much empirical support. Bechara's somatic marker hypothesis is the most frequently tested of the models reviewed above, though its relevance to anxiety and mood disorders is unclear. None of the models reviewed above addresses both decision-making under risk and indecisiveness, which is consistent with the fragmentation of the literature, but may also suggest that these two types of decision-making impairment are independent from one another.

## **Decision-Making Impairment in Emotional Disorders**

Research on decision-making impairment in psychiatric disorders is disjointed, with one line of inquiry, informed by Bechara's (1994) somatic marker hypothesis, focused on decision-making under risky conditions, and another focused on indecisiveness. Thus, the review below attempts to clarify the nature of the decision-making deficits under study, as well as the methods used to assess them. Unipolar depression, generalized anxiety disorder (GAD), and OCD are the focus of this review, both because clinical descriptions of these disorders have suggested decision-making impairment and because of the phenomenological similarity and high rates of comorbidity between them (Brown, Campbell, et al., 2001; Brown, Abramowitz & Foa, 1998).

**Unipolar depression.** Most investigations of decision-making under risk in unipolar depression have relied on the IGT or other gambling tasks. The results of several studies suggest that patients with depression exhibit impaired performance (i.e., earn fewer points or less money) relative to non-depressed participants on these tasks (Murphy et al., 2001; Must et al., 2006). Contrary to evidence that depression is associated with decreased reward sensitivity (Eshel & Roiser, 2010), depressed patients' performance in one study appeared consistent with increased sensitivity to short-term reward and blunted reactivity to punishment on a modified version of the IGT (Must et al., 2006). Additional evidence for the effect of sadness and depression on decision-making comes from studies involving affective inductions in nonclinical samples. In one such study, sad individuals exhibited greater preference for high-risk/high-reward options than anxious individuals

on a task requiring them to choose between a variety of options with defined odds (Raghunathan & Pham, 1999), results that suggest that anxiety and depression may produce distinct effects on tasks assessing decision-making under risk.

Not all studies, however, have found that depressed patients exhibit impaired performance on tasks designed to assess risky decision-making and reward- and punishment-based learning. Jollant et al. (2007) failed to find an association between unipolar depression and impaired IGT performance when they controlled for past suicide attempts. Smoski et al., (2008) found that depressed participants' performance on the IGT was superior to normal controls' across all five blocks of trials on the IGT, suggesting greater risk aversion. Of note, neither Jollant et al. (2007) nor Smoski et al. (2008) controlled for the presence of comorbid anxiety disorders.

Given the inclusion of indecisiveness in the diagnostic criteria for MDD and dysthymia, there have been surprisingly few investigations of it in patients with unipolar depression. Because there are no widely used, standardized measures of indecisiveness, these studies have typically relied on tasks designed by the investigators to simulate real-life decision-making. In a study assessing the effect of a rumination induction on indecisiveness, dysphoric and control participants completed a computer-administered task requiring them to choose between two options in a series of decision scenarios (van Randenborgh, de Jong-Meyer, & Hüffmeier, 2010). Dysphoric ruminators were less confident in their decisions, perceived decision-making as more difficult, and exhibited longer decision latencies relative to both non-dysphoric individuals and dysphoric non-ruminators. In another study, depressed inpatients reported more decisional conflict than

healthy controls, with high levels of conflict associated with low self-efficacy, poor concentration, and high levels of rumination (van Randenborgh et al., 2010). Positive associations between self-reported depression and indecisiveness have been documented in nonclinical samples (Rassin et al., 2006; Rassin & Muris, 2005), although Di Schiena, Luminet, Chang, and Philippot (2013) failed to find a significant relationship. None of these studies has attempted to determine the unique contribution of various types of psychopathology to indecisiveness. Of note, the few studies that have reported decision time as a behavioral marker of indecisiveness have found mixed results. Murphy et al. (2001) found that patients with unipolar and bipolar depression took significantly more time to make decisions than control participants on a behavioral gambling task. Van Randenborgh, de Jong-Meyer, and Huffmeier (2009) observed only marginally longer decision times in dysphoric individuals than in control participants.

**Anxiety disorders.** Although not included in the diagnostic criteria for anxiety disorders, decision-making impairment has been proposed as the core deficit in OCD (Sachdev & Malhi, 2005) and investigated as a correlate of GAD (Mueller, Nguyen, Ray, & Borkovec, 2010). Similar to the literature on depression and decision-making, research linking anxiety to decision-making impairment includes both studies of decision-making in the context of risk and indecisiveness.

Anxiety signals the presence of threat and promotes protective responses (Barlow, 2004). Is it not surprising, therefore, that multiple studies have demonstrated that anxiety, operationalized in various ways, is associated with risk-averse decision-making in nonclinical and clinical samples (Heilman, Crişan, Houser, Miclea, & Miu, 2010; Maner

et al., 2007; Mueller et al., 2010). High scorers on a self-report measure of GAD symptoms learned to avoid decisions with a high probability of long-term losses faster than non-anxious control participants (Mueller et al., 2010) and individuals with non- hoarding OCD demonstrated comparable IGT performance to community controls (Grisham, Brown, Savage, Steketee, & Barlow, 2007; Lawrence et al., 2006; Nielen, Veltman, de Jong, Mulder, & Boer, 2002). Nevertheless, some studies using the IGT or similar paradigms have found that anxiety, and OCD in particular, is associated with impaired decision-making (Cavedini et al., 2002; Kashyup, Kumar, Kandavel, & Reddy, in press; Miu, Heilman, & Houser, 2008). Furthermore, there is some indication that patients with OCD exhibit superior performance to control participants on a gambling task in which the rules are made explicit (Starcke et al., 2010). One study has found differential performance between anxiety disorders on the IGT, with patients with OCD demonstrating greater risk taking (i.e., poorer performance) than both healthy controls and individuals with panic disorder (Cavedini et al., 2002).

Like depression, anxiety disorders have long been associated with indecisiveness, with Milner et al. (1971) linking obsessiveness to decision deferral and Fava, Savron, Rafanelli, Grandi, and Canestrari (1996) identifying indecisiveness as a prodromal symptom of OCD. Nevertheless, there is limited empirical evidence of a relationship between OCD and indecisiveness. Significant correlations have been observed between self-reported indecisiveness and OCD symptoms (Rassin et al., 2007), with some indication that indecisiveness is most strongly associated with doubting and checking symptoms (Frost & Shows, 1993). Using a behavioral decision-making task, Foa et al.

(2003) found that individuals with OCD spent more time deliberating about low-risk decisions (e.g., what car wax to buy) than control participants, and that self-reported OCD symptoms, but not depression symptoms, predicted decision latency.

Despite high rates of comorbidity and phenomenological overlap with depression and OCD (Brown, Campbell, et al., 2001; Brown, Chorpita, & Barlow, 1998), there have been few investigations of the relationship between GAD and indecisiveness. Researchers have found significant zero-order correlations between self-report measures of GAD and indecisiveness (Rassin et al., 2006; Rassin & Muris, 2005) and individuals with OCD report significantly more indecisiveness when GAD is present (Abramowitz & Foa, 1998). In addition, GAD patients exhibit deficits in implementing solutions to problems, report less confidence in their ability to solve problems, and experience lower perceived control over the problem solving process (Davey, 1994; Ladouceur, Blais, Freeston, & Dugas, 1998). Unfortunately, there have been no attempts, theoretical or empirical, to distinguish problem solving from decision-making, though they appear to be overlapping constructs.

**Other psychiatric disorders.** Most recent research examining decision-making and psychopathology has focused on disorders characterized by impulsivity, particularly bipolar I disorder and alcohol/substance dependence. Like patients with damage to the VM, decision-making in individuals with these disorders is characterized by inadequate consideration of negative consequences. Consistent with the clinical features of these diagnoses, individuals with bipolar I and alcohol/substance dependence exhibit deficits on IGT, demonstrating a preference for high-risk/high-reward cards (Grant, Contoreggi,

& London, 2000; Rubinsztein, Michael, Underwood, Tempest, & Sahakian, 2006; Verdejo-García et al., 2007).

**Summary.** The results of studies examining the association between depression and gambling task performance are equivocal, with some suggesting that depression impairs performance (Murphy et al., 2001; Must et al., 2006), and others finding that IGT performance is unaffected (Jollant, et al., 2007) or even enhanced (Smoski et al., 2006) in depressed individuals.

The association between depression and putative markers of indecisiveness is somewhat more consistent than the link between depression and decision-making under risk, with several studies indicating that depression is associated with more distress surrounding the decision-making process (e.g., greater perceptions of difficulty, less confidence in decisions), and multiple studies finding significant bivariate correlations between self-reported depression and self-reported indecisiveness. There is limited evidence, however, of a relationship between depression and prolonged decision times, with few studies having reported this outcome.

The evidence linking anxiety disorders to decision-making impairment is similarly inconsistent and complicated by the use of a variety of tasks purporting to assess similar constructs. Anxiety, broadly defined, appears to be associated with advantageous (i.e., risk-averse) choices on behavioral tasks and self-report questionnaires. Nevertheless, both trait anxiety and OCD symptoms have been linked to impaired performance on the IGT. Studies of the relationship between anxiety and decision-making under risk highlight the importance of examining performance over the

course of the IGT rather than merely using total net score as the primary outcome, given that different types of psychopathology may influence performance on some blocks, but not others (Mueller et al., 2010). Both OCD and GAD are associated at the bivariate level with self-reported indecisiveness, though few studies have confirmed the link between anxiety and indecisiveness using behavioral tasks (Foa et al., 2003).

The link between decision-making impairment and unipolar depression and anxiety disorders has not yet been clearly established. The variety of decision tasks used impedes the comparison of one study to another and the use of subclinical or highly restricted samples (i.e., ones with no comorbid disorders) make it difficult to generalize findings to real-world patients, among whom comorbidity is the rule rather than the exception (Brown, Campbell, et al., 2001). Thus, some of the inconsistency in findings reported above may be due to a failure to consider the effect of comorbid diagnoses on task performance. Furthermore, our understanding of decision-making impairment in anxiety and unipolar mood disorders may be enhanced by the measurement of relevant neuropsychological variables.

### **Neuropsychological Impairment and Decision-Making**

Given that decision-making is such a complex task, one might hypothesize that it is influenced by multiple cognitive skills. Nevertheless, no studies of indecisiveness have included the measurement of potentially relevant cognitive variables (e.g., processing speed). In contrast, numerous studies of risk-related decision-making, frequently studied in neurologic samples, have included measures of cognitive variables.

The IGT was explicitly designed to measure decision-making in the absence of other cognitive deficits, based on the theory that damage to the VM selectively impairs decision-making, while leaving other abilities (e.g., memory, executive functions) preserved (Bechara et al., 1994). Since Bechara et al.'s (1994) original paper on the IGT, however, multiple studies have documented associations between impaired cognitive functions, particularly executive functioning (a broad term that often includes, but is not limited to, set shifting, organization, and response inhibition), and disadvantageous decision-making. Significant correlations have been found between the Trail Making Test (Trails B, in particular) and overall IGT performance among eating disordered patients (Brand, Franke-Sievert, Jacoby, Markowitsch, & Tuschen-Caffier, 2007), patients with substance use disorders, and normal control participants (Barry & Petry, 2008). Researchers have also found significant associations between decision making and other measures of executive functioning (e.g., Noël, Bechara, Dan, Hanak, & Verbanck, 2007).

Few studies have examined the association between performance on cognitive tasks and the IGT among patients with unipolar depression and anxiety, and neither found an association between neuropsychological measures and IGT performance (Jollant et al., 2007; Starcke et al., 2010). A recent review indicated that a minority of studies examining the association between cognitive function and decision-making performance found significant associations between net total scores on the IGT and executive functioning or global measures of intelligence (Toplak, Sorge, Benoit, West, & Stanovich, 2010). Among studies finding significant associations, effect sizes were small to modest, leading the authors to conclude that, consistent with Bechara et al.'s (1994)

original IGT paper, decision-making performance is independent of other cognitive abilities.

Nevertheless, the relationship between decision-making and cognitive function, particularly in the context of anxiety and mood disorders, remains understudied given the array of cognitive deficits that have been documented among individuals with anxiety and depression. Depression has been linked with deficits in memory and executive functioning (Burt, Zembar, & Niederehe, 1995; Goodwin, 1997; Mahurin et al., 2006; Moritz et al., 2002) across a broad range of age groups (e.g., (Abas, Sahakian, & Levy, 1990; Grant, Thase, & Sweeney, 2001; Purcell, Maruff, Kyrios, & Pantelis, 1997; Tarbuck & Paykel, 1995). In addition, patients with depression often exhibit marked psychomotor slowing, as evidenced by slower speech, body movements, and reaction time than healthy adults (Sobin & Sackeim, 1997). Consistent with these observations, depression has been associated with longer decision times on simple (Hickie, Scott, Wilhelm, & Brodaty, 1997) and complex (Murphy et al., 2001) decision-making tasks. Notably, no previous studies have examined the relationship between psychomotor slowing, as measured by standardized neuropsychological tests, depression, and laboratory tasks of decision-making.

Several mechanisms may account for the neuropsychological deficits observed in depressed patients. The resource-allocation hypothesis states that depressed individuals may suffer from decreased cognitive capacity, with depression occupying or functionally reducing their cognitive resources (e.g., Ellis & Ashbrook, 1989). Consistent with this hypothesis, Hasher and Zacks (1979) proposed that individuals with depression are

selectively impaired on effortful tasks (e.g, problem solving, semantic encoding, free recall, speeded tests), whereas their performance on tasks requiring automatic processing (e.g., frequency judgments, retrieval of self-relevant words) is relatively preserved (see Hartlage, Alloy, Vázquez, & Dykman, 1993, for a review). Because “effortful” may be defined in myriad ways, it is unclear how useful the automatic-effortful distinction is in explaining task performance. However, because decision-making likely requires a variety of cognitive skills (e.g., attention, working memory, and response inhibition), it is typically regarded as an effortful task. Motivation may also play an important role in neuropsychological task performance and the conservative response bias observed in some studies has been cited as evidence of depressed patients’ low hedonic capacity relative to nondepressed participants (Meehl, 1975).

The evidence of cognitive dysfunction in anxiety disorders is not as robust as it is for depression (Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, & Lönnqvist, 2008). Whereas few studies have documented neurocognitive deficits in GAD (e.g., Gualtieri & Morgan, 2008), social phobia (e.g., Cohen et al., 1996), and panic disorder (e.g., Lucas, Telch, & Bigler, 1991), numerous studies have found evidence of attention and executive functioning deficits in OCD using a variety of tasks (e.g., Cavallaro et al., 2003; Kim, Park, Shin, & Kwon, 2002; Moritz et al., 2002; Penadés, Catalán, Andrés, Salamero, & Gastó, 2005; Purcell, Maruff, Kyrios, & Pantelis, 1998). At least one study has documented processing speed deficits in the context of OCD (Burdick, Robinson, Malhotra, & Szeszko, 2008).

In summary, there is a paucity of studies examining the association between cognitive deficits in depression and anxiety and decision-making, and no studies explicitly linking neuropsychological test performance to indecisiveness. However, a broader literature examining neuropsychological deficits among individuals with anxiety and depression suggests that processing speed and executive functioning may be particularly vulnerable in these populations and important to study in the context of decision-making. Del Missier, Mäntylä, and Bruin (2011) have recently argued that different cognitive skills may subservise different types of decision-making. Indeed, one might hypothesize that processing speed would be more likely to affect decision latency on a task assessing indecisiveness and, consistent with prior research, executive functions might be more likely to affect performance on the IGT.

### **Clinical Relevance of Decision-Making Impairment**

Despite the inclusion of indecisiveness in the diagnostic criteria for MDD for over 30 years and researchers' argument that deficits in decision-making under risk are critical to understanding a variety of mental disorders (Lee, 2013; Sachdev & Malhi, 2005), the most commonly used manualized treatments for anxiety and unipolar depression do not include interventions that explicitly target decision-making impairment.

Within the career counseling literature, however, researchers have proposed multiple interventions to address vocational indecision (e.g., Mendonca & Siess, 1976; Savickas, 1995). Many of these are derived from D'Zurilla and Goldfried's (1971) problem-solving training (PST). Developed as a treatment for a variety of behavioral problems, PST teaches patients to evaluate the personal, social, short-term, and long-term

consequences of various decision options, and to create a solution plan. The authors' definition of problem solving is similar to others' characterization of effective decision-making: a behavioral process that "makes available a variety of potentially effective response alternatives" and "increases the probability of selecting the most effective response" (p. 108). Problem-solving training has been tested in numerous clinical samples and meta-analyses have supported its efficacy in the treatment of depression (Bell & D'Zurilla, 2009) and a variety of other mental and physical health problems (Malouff, Thorsteinsson, & Schutte, 2007). Studies evaluating PST have examined treatment outcomes using self-report measures of clinical symptoms, but have not assessed patients' performance on behavioral decision-making tasks pre- and post-treatment, so it is unclear if decision-making impairment resolves when depression remits. Although not developed to address decision-making deficits *per se*, cognitive reappraisal, a technique common to many forms of cognitive-behavioral therapy, may alter decision-making by down-regulating negative emotions and increasing adaptive risk-taking (Heilman et al., 2010).

Decision-making may also be relevant to clinical care through its effect on treatment outcome. Elevated perceptions of risk have been associated with lower willingness to seek treatment (Lorian & Grisham, 2011). Cognitive-behavioral therapy for GAD has been found to increase social and recreational risk-taking (Lorian, Titov, & Grisham, 2012), suggesting that, among clinically anxious individuals, decreasing risk aversion may be therapeutic. In contrast, high risk-taking as measured by the IGT predicts poorer response to pharmacological treatment among patients with OCD

(Cavedini et al., 2002), three-month relapse among patients with substance dependence (De Wilde, Verdejo-García, Sabbe, Hulstijn, & Dom, 2013), and self-reported social dysfunction among cocaine-dependent individuals (Cunha, Bechara, de Andrade, & Nicastrì, 2011). These findings not only support the ecological validity of the IGT and measures of risk aversion, but provide evidence that individuals' decision-making abilities may be an important consideration in treatment.

### **Implications for Diagnostic Criteria**

References to decision-making impairment, and indecisiveness in particular, have appeared in the criteria sets for multiple Axis I and II disorders. In addition to its inclusion in the *DSM-5* (APA, 2013) criteria for MDD and persistent depressive disorder (formerly dysthymic disorder), indecisiveness was included in the *DSM-III-R* (APA, 1987) definition of obsessive-compulsive personality disorder, though not retained in *DSM-IV* (APA, 1994). A variation of indecisiveness (“difficulty making everyday decisions without an excessive amount of advice and reassurance from others”) was included in the definition of *DSM-IV* dependent personality disorder.

Despite its appearances in multiple editions of the *DSM*, there is limited evidence to support the inclusion of indecisiveness in the criteria for any disorder. The prevalence of decision-making difficulty among depressed patients is unclear, due in part to the use of compound criteria in the definitions of MDD and dysthymic disorder. Two-thirds of the *DSM-5* criteria (which are identical to the *DSM-IV-TR* criteria) for MDD are compound, meaning that they include multiple features (e.g., difficulty concentrating and indecisiveness) or contrasting symptoms (e.g., excessive sleep and insomnia). Noting the

dearth of research documenting the sensitivity and specificity of the MDD criteria, Mitchell et al. (2008) examined the performance of the *DSM-IV-TR* criteria in a large sample of psychiatric outpatients. Indecisiveness, rated by interviewers administering structured diagnostic interviews, was highly accurate in discriminating depressed from non-depressed patients (i.e., endorsed by the majority of patients diagnosed with MDD, but rarely reported by those without MDD). However, an earlier study by the same research group found that indecisiveness was endorsed by only 5.6% of patients meeting the mood or loss of interest criteria for MDD, leading the authors to suggest that the cognitive disturbance criterion be simplified to include only impaired concentration (Zimmerman, Chelminski, McGlinchey, & Young, 2006).

Indecisiveness (or “difficulty making decisions”) has been retained in the *DSM-5* (APA, 2013) diagnostic criteria for MDD and persistent depressive disorder despite the absence of an empirical basis for its inclusion. Of note, early in the *DSM-5* revision process, Andrews et al. (2010) proposed new criteria for GAD that included several behavioral manifestations of anxiety, including “marked procrastination in behavior or decision-making due to worries” (p. 144). Indecisiveness has also been studied as one of the defining features of hoarding (Frost, Tolin, Steketee, & Oh, 2011) and indecision associated with discarding was included in proposed criteria for hoarding disorder (Mataix-Cols et al., 2010). Although it was ultimately not included in the *DSM-5* definitions of GAD or hoarding disorder, indecisiveness’s inclusion in proposed criteria sets suggests that it is a clinical phenomenon warranting further study.

No previous studies have attempted to determine whether indecisiveness is associated with multiple measures of psychopathology in a clinical sample. Thus, one of the goals of the current study was to contribute to the classification literature by determining the specificity of the relationship between certain emotional disorders and decision-making impairment.

### **Current Study**

Although the study of decision-making has grown dramatically in recent years, our understanding of decision-making impairment in unipolar depression and anxiety disorders remains limited. Much of the research on decision-making has focused on risk-related decision-making rather than indecisiveness, and has only rarely considered the effect of comorbid conditions on decision-making performance. Those studies that have examined indecisiveness have typically not referenced the wider decision-making literature or taken into account the role of various neurocognitive skills (e.g., processing speed) in decision-making impairment. Moreover, many investigations of decision-making impairment in unipolar mood and anxiety disorders have been analog studies, relying on nonclinical samples and mood inductions to make inferences about the decision-making of individuals with emotional disorders.

Basic questions about the nature of decision-making in anxiety and mood disorders remain unanswered: Do depression and anxiety (specifically, GAD and OCD) independently predict self-reported indecisiveness? Are depression and anxiety associated with behavioral correlates of indecisiveness (e.g., prolonged decision times)? Do depression and anxiety predict differential performance on tasks assessing risky

decision-making? Are associations between psychopathology and decision-making performance mediated by neurocognitive variables? Is decision-making impairment in anxiety and mood disorders associated with real-life functional impairment?

The current study is an initial attempt to answer these questions and to integrate the disparate modes of inquiry that have characterized decision-making research by: (1) studying a treatment-seeking clinical sample that has undergone extensive diagnostic assessment; (2) employing multiple decision-making tasks, including one designed for this study to simulate real-life decision scenarios; and (3) measuring multiple variables (e.g., self-reported psychopathology, cognitive functions) that might account for individuals' performance on decision-making tasks.

## **Method**

### **Participants**

Seventy-five participants were recruited from patients who presented for assessment and treatment at the Center for Anxiety and Related Disorders (CARD). Patients were recruited for the study if they met criteria for any anxiety or unipolar mood disorder based on a diagnostic assessment using the Anxiety Disorders Interview Schedule for *DSM-IV*: Lifetime Version or a follow-up assessment using the non-lifetime version of the ADIS (ADIS-IV-L; Di Nardo, Brown, & Barlow, 1994). Patients were eligible for the study if they met criteria for MDD, dysthymic disorder, depression not otherwise specified (NOS), GAD, OCD, panic disorder with or without agoraphobia, specific phobia, posttraumatic stress disorder (PTSD), social phobia, or anxiety disorder

NOS as either a principal or additional diagnosis. Patients were excluded from the study if they were diagnosed with ADHD, bipolar disorder, or alcohol/substance use disorders.

Due to technical problems, one participant did not complete the computer-administered tasks. Although no participant received a diagnosis of ADHD during his or her diagnostic assessment at CARD, nine reported having previously been diagnosed with the disorder. Of these individuals, only one reported currently interfering symptoms of ADHD and exhibited marked difficulty completing the neuropsychological and computer-administered testing. Data from this participant have been excluded from all analyses.

The most common principal or co-principal diagnoses were social phobia, generalized anxiety disorder, and panic disorder (Table 1). The majority of the sample ( $n = 43$ , 58%) met criteria for two or more Axis I diagnoses. A CSR of 6 or 7, indicative of severe symptoms, was assigned to the principal diagnosis in 40.5% of cases. Fifty-two (70.3%) individuals were recruited after their participation in intake assessments and 22 (29.7%) were recruited after follow-up assessments. The majority of participants ( $n = 62$ , 83.8%) were right-handed. Less than half of participants ( $n = 32$ , 43.2%) reported current use of psychotropic medications. The most commonly reported psychotropic medications were antidepressants ( $n = 22$ , 29.7%), anxiolytics ( $n = 19$ , 25.7%), beta-blockers ( $n = 5$ , 6.8%), and stimulants ( $n = 4$ , 5.4%). Additional sample demographic characteristics are presented in Table 2.

## **Study Procedures**

*Recruitment.* The experimenter and a recruitment assistant contacted patients by phone following their completion of an intake or follow-up assessment at CARD. If patients agreed to participate in the study, they were scheduled for a two-hour laboratory session. In an attempt to ensure that an adequate range of depressive symptoms was represented in the sample, 21 participants (28% of the total sample) had clinical diagnoses of MDD, MDD in partial remission, dysthymic disorder, and depressive disorder NOS were recruited.<sup>1</sup>

*Study Session.* Participants signed a consent form, completed self-report questionnaires, neuropsychological measures, and decision-making tasks (described in detail below). The order of the decision-making tasks was counterbalanced. At the end of the study session, participants were provided with a brief description of the study and invited to ask further questions. Participants received a \$25.00 check in return for their participation.

## **Diagnostic Assessment**

*Anxiety Disorders Interview Schedule for DSM-IV: Lifetime Version (ADIS-IV-L;* Di Nardo et al., 1994). The ADIS-IV-L is a semi-structured interview designed for the assessment of current and past anxiety and mood disorders. Reliability estimates for the

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<sup>1</sup> The prospectus for this study called for a total sample size of 70, with half the sample diagnosed with MDD or dysthymic disorder, and at least 15 of those individuals having moderate or severe presentations of MDD. Due to difficulties recruiting patients with depression, the recruitment plan was revised to require that least 20 patients with unipolar depression (MDD of any severity level or course, dysthymic disorder, or depressive disorder NOS) complete the study.

majority of anxiety and mood disorders assessed using the ADIS-IV-L have been in the good to excellent range (Brown, Di Nardo, Lehman, & Campbell, 2001). When administering the ADIS-IV-L, interviewers assign each diagnosis a 0-8 clinical severity rating (CSR) that represents the degree of distress and/or functional impairment associated with that set of symptoms. The interviewers assign a “principal” diagnosis to the set of symptoms that is most severe. All other diagnoses are labeled as “additional.”

### **Self-Report Measures**

*Beck Depression Inventory-II (BDI-II;* Beck, Steer, & Brown, 1996). The BDI-II is a widely used measure of depression. It consists of 21 items and includes items that assess cognitive-affective symptoms of depression and nonspecific symptoms related to general distress and negative affect (e.g., irritability, sleeplessness). Items are summed to create a total score.

*Indecisiveness Scale (IS;* Frost & Shows, 1993). The 15 items of the IS are measured on a Likert-type scale ranging from one (“strongly disagree”) to five (“strongly agree”) and are summed to create a total score. Higher scores are associated with stronger levels of indecisiveness. In nonclinical samples, the IS has demonstrated high internal consistency (.90; Frost & Shows, 1993), high four-week test-retest reliability (Rassin et al., 2006), and significant zero-order correlations with measures of depression, worry, and OCD symptoms (Frost & Shows, 1993; Gayton et al., 1994). High scores have been associated with longer decision latencies on a behavioral decision-making task (Frost & Shows, 1993).

Of note, the IS has infrequently been used in studies of clinical samples, with the exception of investigations of hoarding and non-hoarding OCD patients (e.g., Steketee, Frost, & Kyrios, 2003). Although the IS has been criticized for its inclusion of both domain-specific (“When ordering from a menu, I usually find it difficult to decide what to get”) and general items (“I find it easy to make decisions”), and for its unidimensional measurement of a supposedly multidimensional construct (Gayton et al., 1994; Rassin, 2007), it remains the most widely used measure of indecisiveness in clinical psychology.

*Obsessive-Compulsive Inventory—Revised (OCI-R; Foa et al., 2002).* The OCI-R is an 18-item measure that assesses six types of OCD symptoms: checking/doubting, obsessing, mental neutralizing, ordering, hoarding, and harming. The respondent rates the distress associated with each symptom on a five-point scale ranging from zero (“not at all”) to four (“extremely”). Items are summed to create a total score. The OCI-R has demonstrated good internal consistency and test-retest reliability in a sample of patients diagnosed with a variety anxiety disorders, as well as in a sample of control participants (Foa et al., 2002).

*Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990).* The PSWQ is a 16-item measure of trait worry. Items are scored on Likert-type scale ranging from one (“not at all typical of me”) to five (“very typical of me”) and summed to create a total score. The measure exhibits unidimensional structure, sufficient reliability, and convergent and discriminant validity in nonclinical samples and in patients diagnosed with a variety of mood and anxiety disorders (Brown, 2003; Brown, Antony, & Barlow, 1992; Meyer et al., 1990).

*Subjective Symptoms Scale (SSS; Hafner & Marks, 1976).* The SSS is a five-item scale assessing how much current symptoms interfere with work, home management, private leisure, social leisure, and family relationships. The respondent rates each item on a nine-point scale ranging from zero (“not at all”) to eight (“severe”). Prior studies have supported the unidimensionality of the SSS (Brown & Barlow, 1995).

*Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995).* The BIS-11 is a 30-item scale assessing the personality trait of impulsiveness. Respondents rate items (e.g., “I make up my mind quickly,” “I act on the spur of the moment”) on a four-point scale ranging from one (“rarely/never”) to four (“almost always/always”). The BIS-11 has demonstrated adequate psychometric properties (Patton et al., 1995). Although the BIS-11 contains three subscales intended to assess different components of impulsivity (attentional, motor, and non-planning), there is little evidence to support a three-factor structure (Steinberg, Sharp, Stanford, & Tharp, 2013).

*Demographics Questionnaire.* All participants completed a brief questionnaire on which they reported their age, race, ethnicity, education level, employment status, and handedness. In addition, participants were asked to report whether they were currently taking psychotropic medication, or had ever received a diagnosis of ADHD or learning disorder at a prior diagnostic evaluation.

### **Neuropsychological Measures**

*Iowa Gambling Task (IGT; Bechara, 2007).* The IGT is a computer-administered card game designed to assess emotional decision-making (see Appendix A for task instructions and Appendix B for a screenshot of the task). The participant chooses 100

cards from four decks, two of which, A and B, are “high risk” (associated with intermittent large rewards and long-term losses) and two of which, C and D, are “low risk” (associated with small, consistent gains). For every ten cards selected from decks A and B, respondents experience a net loss of \$250, whereas they experience a net gain of \$250 for every ten cards selected from decks C and D. Individuals without neurological or psychiatric disorders typically learn to avoid the riskier decks. Net scores were calculated by subtracting the total number of disadvantageous cards selected from the total number of advantageous cards selected. Higher scores signify more advantageous and risk-avoidant decision-making. Evaluation of IGT performance often involves repeated measures analysis of performance over the course of five blocks of trials (e.g., Lawrence et al., 2006). Although the IGT was originally described as a measure of risky decision-making (Bechara et al., 1994), Dunn et al. (2006) and others have argued that initial blocks actually measure decision-making under conditions of ambiguity. Later blocks, by which time respondents have become aware, either implicitly or explicitly, of reward contingencies, are believed to be purer measures of risky decision-making. The IGT records the total net score, net score per block, total number of card selections from each deck, and decision time (in milliseconds) for each card selection.

*Wechsler Scales of Intelligence Subtests, 3<sup>rd</sup> Edition (WAIS-III; Wechsler, 1997).*

The WAIS-III Vocabulary, Matrix Reasoning, and Digit Symbol Coding subtests were administered to obtain estimates of verbal and nonverbal intelligence, and psychomotor speed. The Vocabulary subset requires participants to define 35 words that are presented orally and visually. The subtest is considered a measure of expressive vocabulary, verbal

knowledge, and general intelligence. Performance on the subtest tends to be consistent even in the context of neurological or psychological disturbance (Lezak, 1995). The Matrix Reasoning subtest consists of 26 incomplete visual patterns designed to assess visuospatial ability and general intellectual functioning. Participants are instructed to examine each pattern and identify the piece that best complete the pattern from among five choices. Digit Symbol-Coding is a timed task requiring participants to copy abstract symbols associated with numbers. The number of symbols correctly filled in after 120 seconds serves as a measure of psychomotor speed.

*Trail Making Test* (Reitan & Wolfson, 1985). The Trail Making Test consists of two parts. Trails A, a test of simple attention and motor speed, requires participants to connect numbered circles in order from one to 25. Trails B, a test of sustained attention, set shifting, and cognitive flexibility, requires participants to connect 25 circles, alternating between numbers and letters.

*Stockings of Cambridge (SOC)*; Cambridge Automated Neuropsychological Test Battery (CANTAB), 1995). A modified version of the Tower of London (Shallice, 1982), the SOC is a measure of planning and frontostriatal function. The task was administered on a touch-screen monitor and required participants to rearrange colored balls in a specified number of moves to match a target arrangement. Task difficulty varied according to the number of moves required to match the target arrangement. Measurements included the number of perfect solutions (i.e., problems solved in the minimum number of moves) and time spent planning the sequence of moves before

initiating an action. The latter measurement, which excludes the influence of motor speed, was examined in the current study as a behavioral marker of indecisiveness.

### **MouselabWEB Decision-Making Task**

An experimenter-designed decision-making task was programmed using MouselabWEB (Willemsen & Johnson, 2004) to simulate decisions individual might face in their daily lives. MouselabWEB is the web-based version of Mouselab, a software application that allows researchers to examine respondents' decision-making in detail (Payne, Bettman, & Johnson, 1988). No previous studies have used MouselabWEB to study decision-making in clinical samples, but MouselabWEB has been used to study the effect of time pressure and information valence on individuals' decision-making strategies (Maule, Hockey, & Bdzola, 2000) and to simulate decisions about healthcare plans (Barnes, Hanoch, Wood, Liu, & Rice, 2013).

Similar to non-computer-administered tasks used in previous studies (e.g., Isen & Means, 1983), the MouselabWEB task required participants to make decisions based on multiple pieces of information. Items were intended to simulate decisions that participants might make in their daily lives (e.g., which camera to buy, which course to take). The items were reviewed and completed by several CARD staff members and patients and revised to increase the relevance and clarity of the decision scenarios. The final version of the task consisted of nine decision scenarios, each presented as a matrix (i.e., three to four choice options described along three to five attributes) (Appendix D). Participants "uncovered" information about each choice option by passing the cursor over cells in the matrix, with only one cell was visible at a time. The primary dependent

variable measured by the MouselabWEB was the average time that participants spent making the decision. Participants also rated the difficulty of each decision scenario on a Likert-type scale ranging from one (“very easy”) to five (“very difficult”) and the similarity of each scenario to decisions they make in their daily lives on a Likert-type scale ranging from one (“very different”) to five (“very similar”).

### **Study Design**

Previous studies examining decision-making in patients with anxiety and mood disorders have typically relied on between-group designs that compared one diagnostic group to another (e.g., Murphy et al., 2001) or a patient sample to a control group (e.g., Starcke et al., 2010). There are significant limitations to these approaches when studying emotional disorders. High rates of comorbidity have been found among anxiety disorders and between anxiety and mood disorders, with one study indicating that 69% of individuals with a principal diagnosis of MDD also meet criteria for an anxiety disorder diagnosis (Brown, Campbell, et al., 2001). Furthermore, among individuals meeting criteria for a principal anxiety disorder diagnosis, rates of comorbid MDD ranged from 27% (in cases of principal specific phobia) to 90% (in cases of principal PTSD) (Brown et al., 2001). Although one could examine decision-making impairments in emotional disorders by comparing diagnostic groups, this approach would ignore the fundamentally dimensional nature of anxiety and mood disorders (Brown & Barlow, 2005). In the current study, all participants completed the same study protocol and levels of depression and anxiety were measured with self-report questionnaires or indicated by codes representing the presence or absence of diagnoses of interest.

## **Hypotheses**

### *Hypotheses Related to Indecisiveness*

*Hypothesis 1.* Consistent with prior research and clinical descriptions of depression and OCD, self-reported depression and OCD symptoms were both expected to uniquely predict self-reported indecisiveness, while controlling for the effects of worry. This hypothesis was tested by regressing IS scores on BDI-II, OCI-R, and PSWQ scores.

*Hypothesis 2.* To determine if self-reported depression, OCD symptoms, and worry were predictive of putative markers of indecisiveness (decision latency and perceived decision difficulty), four regressions were conducted, in which decision time on the MouselabWEB task, decision time on the IGT, initiation time on the SOC, and difficulty ratings on the MouselabWEB task, respectively, were regressed on BDI-II, OCI-R, and PSWQ scores. Although the evidence for the effect of psychopathology on decision latency is mixed, it was predicted that depression would be uniquely associated with longer decision times on the MouselabWEB task and the IGT. Given evidence that depression is associated with perceptions of decision-making difficulty (van Randenborgh et al., 2010), depression was also expected to predict difficulty ratings on the MouselabWEB task while controlling for worry and OCD symptoms.

*Hypothesis 3.* It was predicted that processing speed would partially mediate the relationship between psychopathology and markers of indecisiveness (decision times on the MouselabWEB task and the IGT). To test these hypotheses, path analyses were conducted to test the significance of the direct and indirect paths between measures of psychopathology, processing speed, and decision time.

*Hypothesis 4:* Self-reported indecisiveness was hypothesized to mediate the relationship between psychopathology and functional impairment. Path analysis was used to estimate the direct and indirect paths between measures of psychopathology, scores on the IS, and scores on the SSS.

*Hypothesis Related to Risky Decision-Making*

*Hypothesis 1.* Because there is some evidence that anxious patients are more risk-avoidant than depressed patients on laboratory gambling tasks (e.g., Maner et al., 2007; Raghunathan & Pham, 1999), worry and OCD symptoms, but not depression, were expected to significantly and positively associated with overall performance on the IGT. To test this hypothesis, a regression analysis was conducted with net total score earned on the IGT as the outcome variable, and BDI-II, OCI-R, and PSWQ scores entered as predictors.

*Hypothesis 2.* To determine whether scores on tasks of executive functioning partially mediate the relationship between self-reported depression or anxiety and overall IGT performance, a path analysis that the BDI-II, OCI-R, PSWQ as predictors, the number of perfect solutions and performance on Trails B as mediators, and net total score on the IGT as the outcome.

*Hypothesis 3.* Latent growth modeling (LGM) was used to examine performance on the IGT over five blocks of trials. Significant individual variation in the Slope factor was expected in the unconditional LGM. The addition of categorical diagnoses as covariates was expected to account for significant variance in Slope over the five blocks of trials. Although the evidence for the effect of unipolar depression and anxiety

disorders on IGT performance is mixed, it was hypothesized that anxiety (defined as the presence of GAD or OCD) would be significantly and positively associated with the Slope factor, indicating greater change in IGT performance from Block 1 through Block 5. Depression was expected to be significantly and negatively associated with Slope, indicating less change in IGT performance over the course of the task.

#### *Power Analysis*

Although few previous studies have examined decision-making in patients with anxiety and mood disorders, there is evidence of medium to large effect sizes on the IGT when different patient groups were compared with one another (Murphy et al., 2001). Cohen (1992) defines a medium effect size in multiple regression (based on the omnibus  $R^2$ ) as 0.15. A power analysis based on an effect size of 0.15, an alpha level of 0.05, and three predictors in a multiple regression equation suggested a sample size of 68.

## **Results**

### **Data Analysis**

Data were inspected in SPSS Statistics (version 21). Tests of skewness and kurtosis were conducted on all variables prior to their inclusion in analyses. Because many variables exhibited significant departures from normality, all regression, mediation, and latent growth analyses were conducted in Mplus 7 for Macintosh (Muthén & Muthén, 1998-2012) using the MLR estimator (maximum likelihood estimation with robust standard errors). Missing data were accommodated using direct maximum likelihood (MLR).

Goodness of fit of latent growth models (LGMs) was evaluated using the root

mean square error of approximation (RMSEA) and its 90% confidence interval and test of close fit (CFit), the Tucker-Lewis index (TLI), the comparative fit index (CFI), and the standardized root mean square residual (SRMR). Acceptable model fit was defined in part by the criteria described by Hu and Bentler (1999): RMSEA values  $\leq .06$  (90% CI upper limit close to .06, nonsignificant CFit), CFI and TLI values  $\geq .95$ , and SRMR values  $\leq .08$ . Model fit was further evaluated by the presence/absence of salient localized areas of strains in the solutions (e.g., modification indices), and the strength and interpretability of the parameter estimates.

### **Characteristics of the MouselabWEB Task**

A summary of parameters measured by the MouselabWEB task is presented in Table 3. Participants' ratings of the MouselabWEB scenarios were examined to determine if the scenarios adequately simulated real-life decision-making. Mean similarity ratings assigned to the scenarios ranged from 1 (very different from a real-life decision) to 5 (very similar to a real-life decision). Similarity ratings on individual scenarios ranged from 3.29 ( $SD = 1.24$ ) for the scenario about choosing between three jobs to 4.07 ( $SD = 1.13$ ) for the scenario requiring participants to decide which project to work on next.

The choice options presented in the decision scenarios were intended to be equivalent, with no clear "correct" or superior choice. However, in five of the nine scenarios, the majority of participants selected the same choice option. Bias toward a particular choice was most evident on a scenario requiring participants to choose from among three computers, with 93.2% of participants selecting the same option.

The mean difficulty rating participants assigned to the decision scenarios ranged from scale from 1 (very easy) to 5 (very difficult). Mean difficulty ratings ranged from 1.70 ( $SD = 1.00$ ) on the computer scenario to 2.71 ( $SD = 1.21$ ) on the car scenario. There was a significant, positive correlation between mean similarity ratings and mean difficulty ratings ( $.34, p < .01$ ) and a significant positive correlation between mean difficulty ratings and total time spent on the task ( $.42, p < .01$ ).

### **Neuropsychological Test Performance**

The sample, as a whole, performed well above average on WAIS subtests (Table 3). When participants' raw scores were compared to age-adjusted norms, 73% ( $n = 54$ ) of the sample scored in the 50<sup>th</sup> percentile or higher on Digit Symbol Coding, 95.9% ( $n = 71$ ) scored in the 50<sup>th</sup> percentile or higher on Vocabulary, and 93.2% ( $n = 69$ ) scored in the 50<sup>th</sup> percentile or higher on Matrix Reasoning.

### **Results Related to Indecisiveness**

#### *Hypothesis 1: Relationship Between Psychopathology and Self-Reported Indecisiveness*

Total IS scores were regressed onto BDI-II, PSWQ, and OCI-R scores. The overall model was significant, accounting for 25.4% of the variance in IS scores ( $z = 3.08, p < .01$ ), with self-reported depression ( $B = .38, t = 2.94, p < .01$ ) and OCD symptoms ( $B = .33, t = 2.83, p < .01$ ) contributing significantly to the model. Self-reported worry ( $B = .03, t = .18, p = .86$ ) did not significantly predict indecisiveness while controlling for the effects of depression and OCD symptoms.

Because most previous studies of the association of decision-making with anxiety and/or mood disorders have used diagnosis as a unit of analysis, the analysis was rerun

using diagnostic status as predictors. Patients were coded as having depression if they received a clinical diagnosis ( $CSR \geq 4$ ) of MDD or MDD in partial remission, dysthymic disorder, or depressive disorder not otherwise specified during their diagnostic evaluation. Although the path between depression and IS scores was significant and in the predicted direction,  $B = 6.58$ ,  $t = 2.43$ ,  $p < .05$ , the overall model was not significant,  $R^2 = .07$ ,  $z = 1.31$ ,  $p = .20$ .

*Hypothesis 2: Relationship Between Psychopathology and Behavioral Markers of Indecisiveness*

The next set of analyses examined the association between self-reported psychopathology (depression, OCD symptoms, and worry) and two markers of indecisiveness, decision time and perceived decision difficulty. The first equation, in which decision time on the MouselabWEB task was regressed on BDI-II, OCD-R, and PSWQ scores was nonsignificant,  $R^2 = .03$ ,  $z = .76$ ,  $p = .45$ . The second, in which total time on the IGT was the outcome, was also nonsignificant,  $R^2 = .02$ ,  $z = .44$ ,  $p = .66$ . The third model, in which mean initiation time on the SOC, was regressed on BDI-II, OCI-R, and PSWQ scores, was nonsignificant,  $R^2 = .01$ ,  $z = .56$ ,  $p = .58$ . The fourth model, in which mean difficulty ratings on the MouselabWEB scenarios were regressed on BDI-II, OCI-R, and PSWQ scores, was significant, accounting for 15.3% of the variance in difficulty ratings,  $z = 2.01$ ,  $p < .05$ . The relationship between self-reported depression and difficulty ratings was significant,  $B = .02$ ,  $t = 2.91$ ,  $p < .01$ . Self-reported worry ( $B = .00$ ,  $t = .42$ ,  $p = .68$ ) and OCD symptoms ( $B = .01$ ,  $t = 1.44$ ,  $p = .15$ ) did not significantly contribute to the variance in difficulty ratings. When the above regression analyses were

repeated using diagnostic status as predictors, all models were nonsignificant ( $p$ s ranging from .11 to .94).

*Hypothesis 3: Processing Speed as a Mediator of the Relationship Between Psychopathology and Decision Time*

There were no significant direct relationships between self-reported psychopathology and decision time, indicating that traditional conditions for mediation were not met (Baron & Kenny, 1986). Per the recommendations of Hayes (2009), however, mediation analyses were still conducted. Just-identified models were specified that allowed for significance testing of indirect effects on decision time. In the first model (Figure 1), Digit Symbol Coding was tested as mediator of the relationship between self-reported psychopathology (BDI-II, PSWQ, and OCI-R) and decision time on the MouselabWEB task. The model did not account for significant variance in MouselabWEB decision time ( $R^2 = .05$ ,  $z = .91$ ,  $p = .36$ ). None of the direct paths from the psychopathology variables to decision time were significant ( $p$ s ranging from .15 to .95). The indirect paths from the psychopathology variables to decision time were also nonsignificant ( $p$ s ranging from .95 to .97), indicating that processing speed did not mediate the relationship between self-reported psychopathology and decision time on the MouselabWEB task. A second model was specified in which decision time on the IGT was the outcome. This model did not account for significant variance in total time spent on the IGT ( $R^2 = .01$ ,  $z = .46$ ,  $p = .65$ ). No significant direct effects were observed between psychopathology and decision time ( $p$ s ranging from .50 to .71). All indirect paths between psychopathology and IGT decision time were nonsignificant ( $p$ s ranged

from .73 to .89), indicating that processing speed did not mediate the relationship between psychopathology and IGT decision time.

*Hypothesis 4: Self-Reported Indecisiveness as a Mediator of the Relationship Between Psychopathology and Functional Impairment*

A just-identified path model was specified to test the hypothesis that self-reported indecisiveness partially mediated the relationship between self-reported psychopathology and functional impairment (Figure 2). Although the model accounted for significant variance in SSS scores,  $R^2 = .25$ ,  $z = 3.00$ ,  $p < .01$ , only the direct path between BDI-II and SSS was significant,  $B = .07$ ,  $t = 3.08$ ,  $p < .01$ . None of the indirect paths between psychopathology and functional impairment were significant ( $ps$  ranged from .43 to .84), indicating that self-reported indecisiveness did not mediate the relationship between psychopathology and functional impairment.

**Results Related to Decision-Making Under Risk**

*Hypothesis 1: Psychopathology as Predictors of IGT Performance*

Total net scores were regressed onto BDI-II, OCI-R, and PSWQ scores to determine the effect of self-reported depression, OCD symptoms, and worry on overall IGT performance. The equation was not significant,  $R^2 = .05$ ,  $z = .88$ ,  $p = .38$ . The model was rerun using categorical diagnoses as predictors. Although the path from GAD to total net score was significant,  $B = -18.32$ ,  $t = -2.65$ ,  $p < .01$ , the overall equation was not,  $R^2 = .10$ ,  $z = 1.56$ ,  $p = .12$ .<sup>2</sup>

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<sup>2</sup> Given the unusually high proportion of left-handed participants in the sample—16.2% versus 10% in the general population (Gilbert & Wysocki, 1992)—handedness was

Given evidence that initial blocks on the IGT might assess a different type of decision making than later blocks (e.g., Dunn et al., 2006), exploratory regression analyses were conducted for which Blocks 1 and 2 were summed to create a Phase 1 score and scores from Blocks 3 through 5 were summed to create a Phase 2 score. Phase 1 scores were regressed on BDI-II, OCI-R, and PSWQ scores. The model was nonsignificant, accounting for 5.0% of the variance in Phase 1 scores,  $z = 1.20$ ,  $p = .23$ . Next, Phase 2 scores were regressed on self-report measures of psychopathology. This model was also nonsignificant, accounting for 4.1% of the variance in Phase 2 scores,  $z = .88$ ,  $p = .38$ . When the models were rerun with categorical diagnoses as predictors, the variance accounted for in IGT Phase 1 scores remained nonsignificant,  $R^2 = .04$ ,  $z = 1.00$ ,  $p = .32$ , whereas a trend was evident in Phase 2 scores,  $R^2 = .13$ ,  $z = 1.86$ ,  $p = .06$ . The path between GAD and IGT performance was significant,  $B = -15.51$ ,  $t = -2.64$ ,  $p < .01$ , indicating that a GAD diagnosis was associated with significantly worse IGT performance in Blocks 3 through 5, controlling for comorbid depression and OCD.

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considered for inclusion as a covariate in analyses involving neuropsychological measures. When relevant predictors and outcome variables (Digit Symbol Coding, Trails B, number of perfect solutions on the SOC, and overall IGT performance) were regressed onto handedness, the associations were not significant. Consequently, handedness was not included in the analyses. Age was also not originally included as a covariate. However, there is a large literature documenting age-related decline in processing speed (e.g., Salthouse, 1996) and several studies have demonstrated a relationship between age and decision-making on the IGT (e.g., Fein, McGillivray, & Finn, 2007). In the current sample, there were significant zero-order correlations between age and Digit Symbol Coding, Trails B, and total time spent on the IGT. When added as a covariate to models predicting markers of indecisiveness (decision time and perceived decision difficulty) and IGT performance, age was not significantly associated with the outcomes, nor did its inclusion alter the significance of the relationships between other predictors and outcomes.

*Hypothesis 2: Executive Functioning as a Mediator of the Relationship Between Psychopathology and IGT Performance*

Just-identified path models were specified to test the hypothesis that executive functioning mediated the relationship between psychopathology and overall IGT performance. In the first model, self-reported psychopathology (BDI-II, OCI-R, and PSWQ scores) were exogenous variables, Trails B and the number of perfect solutions on the SOC were mediators, and total net score on the IGT was the outcome. Direct paths were specified from the three psychopathology variables to all other variables, and from the mediators to the IGT net total score. Indirect effects were estimated from the psychopathology variables to IGT net total score via each of the mediators. The model did not account for significant variance in IGT net total scores,  $R^2 = .14$ ,  $z = 1.80$ ,  $p = .07$ . The only significant direct effect was between the SOC variable and IGT net total score,  $B = 5.29$ ,  $t = 2.89$ ,  $p < .01$ , indicating that a one-point increase in planning ability on the SOC was associated with a 5.29-point increase in IGT net score, holding constant scores on the BDI-II, OCI-R, PSWQ, and Trails B. No significant indirect effects were observed between psychopathology and IGT net total score ( $ps$  ranged from .26 to .99), indicating that the executive functioning variables did not mediate the relationship between psychopathology and overall IGT performance.

When categorical diagnoses were included in the model instead of dimensional self-report measures, the model accounted for significant variance in IGT net total scores,  $R^2 = .17$ ,  $z = 2.10$ ,  $p < .05$ . As in the previous model, the path between the SOC variable and IGT net total scores was significant,  $B = 4.68$ ,  $t = 2.60$ ,  $p < .01$ . In addition, the direct

path between GAD and IGT net total scores was significant,  $B = -15.59$ ,  $t = -2.34$ ,  $p < .05$ . No significant indirect effects were observed between the categorical diagnoses and IGT net total score ( $ps$  ranged from .24 to .99), indicating that executive functioning did not mediate the relationship between categorical diagnoses and overall IGT performance.

Exploratory regression analyses were used to examine predictors of Phase 1 and Phase 2 IGT net scores, this time including the two measures of executive functioning. When Phase 1 scores were regressed on the three categorical diagnoses, the SOC variable, and Trails B, the equation was not significant,  $R^2 = .10$ ,  $z = 1.53$ ,  $p = .13$ . When Phase 2 scores were regressed on the five predictors, the equation was significant,  $R^2 = .23$ ,  $z = 2.73$ ,  $p < .01$ . GAD was significantly and negatively related to Phase 2 IGT scores,  $B = -13.48$ ,  $t = -2.45$ ,  $p < .05$ . The number of perfect solutions on the SOC was significantly and positively related to Phase 2 IGT scores,  $B = 4.12$ ,  $t = 2.71$ ,  $p < .01$ .

### *Hypothesis 3: Predictors of Trajectory of IGT Performance*

To examine performance on the IGT over the course of five blocks of trials, an unconditional LGM was specified. Participants' performance on the IGT was characterized by a nonlinear improvement in scores over the course of the task (Figure 3). Consequently, a nonlinear slope from Block 1 through Block 5 was estimated in the unconditional LGM. The Slope factor loadings were specified as follows for Blocks 1 through Block 5, respectively: 0, \*, \*, \*, 1 (\* = freely estimated). Intercepts of IGT performance were fixed to zero. To improve model fit, correlated residual variances were specified between Blocks 2 through 5. Fit indices suggested good fit,  $\chi^2(4) = 81.29$ ,  $p < .001$ , SRMR = .04, RMSEA = 0.00 (90% CI = 0.00 to 0.14, CFit = .72), TLI = 1.05, CFI

= 1.00. The unstandardized mean of the Intercept factor was -2.29 ( $SE = .86, p = .25$ ). The variance of the Intercept factor (22.32) was not significant ( $p = .49$ ), indicating that there was little individual variability in scores on Block 1. The covariance between the Slope and Intercept factors was nonsignificant ( $p = .44$ ), indicating that performance during Block 1 did not predict overall change in scores over the course of the task. The unstandardized mean of the Slope factor was 9.24 ( $SE = 1.51, p < .005$ ), indicating that the average change in IGT score across five blocks was 9.24 points. The significant variance in the Slope factor (84.27;  $p < .05$ ) indicates considerable individual variability in performance trajectories on the IGT.

An initial conditional LGM with three covariates (categorical variables representing the presence or absence of depression, GAD, and OCD) was specified to determine whether psychopathology contributed to individual variability in Slope. Fit indices were consistent with good model fit,  $\chi^2(25) = 122.21, p < .001$ , SRMR = .04, RMSEA = 0.00 (90% CI = 0.00 to 0.09, CFI = .80), TLI = 1.05, CFI = 1.00. The path from GAD to Slope was significant (unstandardized  $\gamma = -6.40; p < .05$ ), indicating that the presence of GAD was associated with significantly less improvement in IGT performance across Blocks 1 through 5. The path from OCD to Slope was also significant (unstandardized  $\gamma = 7.89; p < .05$ ), indicating that the presence of OCD was associated with significantly more change (i.e., greater improvement) in IGT performance over the course of the task. The path between depression and Slope was not significant. Although the model accounted for 26.8% of the variability in the Slope factor, the  $R^2$  value was not significant ( $p = .11$ ).

To test the hypothesis that both psychopathology (the presence of depression, GAD, and OCD) and executive functioning (Trails B and the number of perfect solutions on the SOC) contributed to individual variability in Slope, a model with five covariates was specified (Figure 4). Fit indices suggested good model fit,  $\chi^2(35) = 145.90, p < .001$ , SRMR = .05, RMSEA = 0.00 (90% CI = 0.00 to 0.09, CFI = .75), TLI = 1.03, CFI = 1.00. Collectively, the covariates accounted for 48.2% ( $p < .01$ ) of the variance in Slope. As in the previous model, the paths between GAD and Slope (unstandardized  $\gamma = -6.46$ , respectively;  $p < .05$ ) and OCD and Slope were significant (unstandardized  $\gamma = 6.47$ ;  $p < .05$ ). The path between depression and Slope was nonsignificant (unstandardized  $\gamma = -6.46$ ;  $p = .16$ ). Trails B was significantly negatively associated with the Slope factor (unstandardized  $\gamma = -.17$ ;  $p < .05$ ), indicating that an increase in Trails B score (i.e., worse set-shifting) was associated with less improvement on the IGT. The path between the SOC variable and the Slope factor was nonsignificant (unstandardized  $\gamma = .85$ ;  $p = .27$ ).

#### *Additional Exploratory Analyses*

To further explore the validity of the IS, Pearson correlations were calculated between IS scores and putative markers of indecisiveness. There were significant bivariate relationships between IS scores and difficulty ratings ( $r = .38, p < .01$ ) and decision time ( $r = .39, p < .01$ ) on the MouselabWEB task. The correlation between IS scores and decision time on the IGT was not significant ( $r = .10, p = .41$ ).

Given the paucity of evidence for an association between IGT performance and functional impairment, a Pearson correlation was calculated between the net total score on the IGT and the SSS. The correlation was nonsignificant ( $r = -.14, p = .24$ ).

All participants completed the BIS-11, a self-report measure of impulsivity. Pearson correlations between the BIS-11 and measures of indecisiveness and risky decision-making were examined to determine if self-reported impulsivity was differentially related to the two types of decision-making impairments. No significant zero-order correlations were found between the BIS-11 and decision time on the MouseLabWEB task ( $r = .03, p = .82$ ), decision time on the IGT ( $r = -.11, p = .37$ ), mean initiation time on the SOC ( $r = -.11, p = .35$ ), or net total score on the IGT ( $r = .20, p = .37$ ).

## **Discussion**

### **Overview of Findings**

The aims of the current study were to characterize decision-making impairment in a clinical sample of patients with anxiety and/or unipolar mood disorders. The study focused on two types of impairment identified in the literature, indecisiveness and risky decision-making, and their relationship to psychopathology (unipolar depression, OCD, and GAD/worry) and neuropsychological variables (processing speed and executive functioning). Self-reported depression and OCD symptoms were significantly and positively associated with self-reported indecisiveness, while controlling for the effect of worry. Contrary to prediction, neither psychopathology nor processing speed was significantly associated with decision time, a behavioral marker of indecisiveness, on the IGT or the experimenter-designed decision-making task. Self-reported depression did, however, predict ratings of decision difficulty on the experimenter-designed decision-making task while controlling for the effects of worry and OCD symptoms.

Neither self-reported psychopathology nor categorical diagnoses significantly predicted overall performance on the IGT, as measured by the net total score (i.e., the total number of disadvantageous card selections subtracted from the total number of advantageous selections). When two measures of executive functioning, Trails B and the total number of perfect solutions on the SOC, were included in a regression equation with categorical diagnoses (depression, GAD, and OCD), the model significantly predicted net total scores on the IGT. An LGM estimating the effects of these predictors on performance over the course of the IGT indicated that the presence of GAD was associated with significantly less improvement in IGT net scores over five blocks of trials, whereas the presence of OCD was associated with significantly more improvement in IGT in in net scores. Trails B performance was also significantly associated with IGT performance, such that an increase in time spent on Trails B (indicative of poorer set shifting) was associated with less improvement in IGT performance over the course of the task.

### **Indecisiveness and Psychopathology**

The current study was the first to examine the association between multiple forms of psychopathology and self-reported indecisiveness on the IS in a clinical sample. The finding that self-reported depression and OCD symptoms are uniquely associated with IS scores is consistent with the inclusion of indecisiveness in the *DSM* definition of MDD and dysthymia (currently persistent depressive disorder) and clinical and empirical literature associating indecisiveness with OCD (Frost & Shows, 1993; Reed, 1976). Similar to Frost and Shows' (1993) finding that self-reported indecisiveness was

positively correlated with decision latency on a behavioral task, IS scores were significantly and positively correlated with decision time on the MouselabWEB task. IS scores were not, however, significantly associated with total decision time on the IGT. Previous studies of IGT performance have rarely examined decision time as an outcome, though at least one study reported longer deliberation times among patients with unipolar and bipolar depression than in control participants (Murphy et al., 2001). The positive association between IS scores and decision time on the MouselabWEB task is perhaps not surprising given that both are face valid tasks of decision-making difficulty covering similar content areas.

A novel, experimenter-designed decision-making task was used in the current study to assess markers of indecisiveness. Although MouselabWEB software offers a promising alternative to similar, experimenter-administered tasks (e.g., Isen & Means, 1983), the current study suggests several modifications to the task. In the current study, no association was observed between psychopathology and decision time on the MouselabWEB task, or between measures of processing speed and decision time. These findings may indicate that the task was insufficiently demanding, a hypothesis supported by the low difficulty ratings assigned to some of the decision scenarios. Furthermore, the decision scenarios may not have adequately simulated the real-life decisions with which patients struggle. Although the similarity ratings suggest the scenarios were reasonable approximations of real-life decisions, the majority described consumer choices (e.g., what camera to buy). The inclusion of more scenarios focused on interpersonal scenarios or

higher-stakes choices may have produced more emotional arousal and longer deliberation times.

The study of indecisiveness is, as mentioned previously, complicated by varying definitions of the construct and a corresponding lack of well-validated measures. The field would benefit from research clarifying nature of the construct (i.e., is it a stable trait that precedes the onset of an Axis I disorder and persists after the remission of that disorder, or a correlate of psychopathology?). Greater clarity in the definition of the indecisiveness would promote hypothesis-testing about indecisiveness's relationship with psychopathology (Potworowski, 2010; Rassin, 2007).

### **Decision-Making Under Risk and Psychopathology**

In the current study, GAD and OCD diagnoses, but not depression, predicted the trajectory of participants' performance over the course of the IGT, with GAD associated with a negative effect on task performance, and OCD associated with a positive effect. Although prior research linking anxiety and unipolar mood diagnoses to IGT performance have been inconsistent, this finding was somewhat contrary to expectation. Given the risk aversion typically found among anxious patients, the differential effects of GAD and OCD are puzzling. Control participants' net scores on the IGT are typically characterized by a steep, positive slope over initial blocks, followed by a relatively flat trajectory over the remaining blocks (Lawrence et al., 2006; Starcke et al., 2010). This pattern indicates that respondents are learning the rules of the task during the initial blocks, and selectively avoiding risky card selections during the latter blocks. The sample in the current study displayed a similar pattern. Results of the LGM suggest, however,

that the presence of GAD impeded performance, whereas OCD may have facilitated learning of the task's risk and reward contingencies.

Previous studies of IGT performance in patients with OCD have produced conflicting results. Starcke et al. (2010) et al. found that patients with OCD exhibited impaired overall IGT performance (i.e., lower total net scores) relative to normal controls. When performance was analyzed by block, patients with OCD underperformed relative to normal controls only on Blocks 3 and 5, suggesting that, despite appearing to learn the rules of the task over the initial blocks, they were unable to maintain their performance over the course of the task. In contrast, Lawrence et al. (2006) found that individuals with non-hoarding OCD displayed comparable performance to normal participants on the IGT. The only other study to assess the influence of GAD on IGT performance found that individuals meeting criteria for GAD (based on a self-report measure of GAD symptoms) outperformed normal controls, as indicated by a higher number of advantageous card selections and a steeper learning curve (Mueller et al., 2010). Of note, the studies described above did not control for the influence of comorbid depression or other anxiety disorders on IGT performance.

The results of the current study may be understood in light of the literature linking GAD to difficulty tolerating ambiguity and uncertainty (Hock, Krohne, & Kaiser, 1996; Ladouceur, Talbot, & Dugas, 1997). Tallis and Eysenck (1994) proposed that worry may lead to an unfocused attentional style and impaired problem solving, particular in ambiguous situations. In fact, high levels of worry are associated with slower categorization of ambiguous stimuli (Metzger, Miller, Cohen, Sofka, & Borkovec, 1990)

and a tendency to view problems as unsolvable (Ladouceur et al., 1998). Although the IGT was designed as a test of risky decision-making (Bechara et al., 1994), some have argued that it is more accurately characterized as a test of decision-making under ambiguity, given that respondents are not informed of the rules of the task (Dunn et al., 2006). Thus, patients with GAD may be particularly susceptible to underperformance on the IGT, as opposed to a gambling task in which the risks and rewards associated with each card selection are explicit (e.g., Rogers et al., 1999). Researchers have proposed alternate scoring systems that acknowledge that performance on initial blocks may reflect a different type of decision-making process than later blocks, by which time most respondents have determined which decks of cards are riskiest (e.g., Dunn et al., 2006; Gansler, Jerram, Vonnorsdall, & Schretien, 2011a). One might expect the presence of GAD to exert a particularly negative influence on performance in the first two blocks of the IGT, during which the rules of the task are most ambiguous. The specification of the LGM did not allow for comparison of performance trajectories over the first two blocks to performance on the latter three blocks. However, regression analyses predicting performance during Phase 1 (Blocks 1 and 2) and Phase 2 (Blocks 3 through 5) indicated that the presence of GAD significantly predicted poor performance only in Phase 2. These results may suggest that individuals with GAD display normal exploratory behavior during these first few blocks of the IGT but, due to difficulty tolerating ambiguity and/or deficits in problem solving, do not learn the contingencies of the task well enough to achieve stable, advantageous (i.e., risk averse) performance in the latter blocks.

As indicated above, the finding that OCD was associated with greater change (i.e., improved performance) over the course of the IGT is not entirely inconsistent with previous findings (which have variously suggested that OCD is associated with impaired or enhanced performance on the IGT). There is some evidence that patients with OCD demonstrate an enhanced negative learning bias, such that they learn faster from negative outcomes than from positive ones, whereas the opposite pattern is evident in control participants (Endrass, Kloft, Kaufmann, & Kathmann, 2010). One might speculate that individuals with OCD are particularly attuned to large losses on the IGT and consequently learn to avoid disadvantageous decks faster than other respondents.

Of note, there is some evidence that risk-taking in the context of anxiety disorders may be associated with treatment-seeking behavior and positive treatment response (Lorian & Grisham, 2011; Lorian Titov, & Grisham, 2012). Although the IGT is based on the assumption that risk aversion is advantageous and risk-taking is disadvantageous, there is, as discussed further below, little evidence of an association between poor performance on the IGT and real-world functional impairment. In a population characterized by pathological risk aversion, evidence of “disadvantageous” performance on the IGT might, in fact, be suggestive of healthy functioning.

### **Decision-Making and Neuropsychological Performance**

The current study proposed that neuropsychological test performance partially mediated the relationship between psychopathology and decision-making. The mediation hypotheses were not supported and, contrary to expectation, no-zero order relationships were observed between psychopathology and decision time, or between psychopathology

and processing speed, despite a large literature linking depression to psychomotor slowing (Sobin & Sackeim, 1997). This failure to find a relationship may be due to the relatively mild levels of depression represented in the sample (McDermott & Ebmeier, 2009). Furthermore, there is evidence that processing speed may be preserved even in the presence of other cognitive deficits in individuals similar in age to participants in the current study (Grant et al., 2001; Porter, Gallagher, Thompson, & Young, 2003).

The relationship between the IGT and other measures of neuropsychological performance has been the subject of debate, with Toplak et al. (2010) arguing that evidence for an association between IGT performance and executive functioning measures is weak. In the current study, measures of planning (number of perfect solutions on the SOC) and set-shifting (Trails B) predicted overall performance, as measured by total net score, whereas only Trails B significantly predicted change in performance over the course of the task. Trails B is typically described as a measure of set shifting, or the ability to respond flexibly to changes in rules or schedules of reinforcement, whereas the SOC is regarded as a measure of planning and/or spatial problem-solving. Both tasks have been broadly associated with activation in the prefrontal cortex (PFC), with some evidence specifically implicating the dorsolateral PFC (Kaller, Rahm, Spreer, Weiller, & Unterrainer, 2010; Schall et al., 2003; Stuss, Bisschop, Alexander, Levine, Katz, & Izukawa, 2001; Zakzanis, Mraz, & Graham, 2005). The association of these tasks with IGT performance in the current study likely reflects their association with proximal or overlapping brain regions. Designed as measure of VM functioning, the IGT is often regarded as a measure of more broad-based frontal-executive functioning, as the area

Bechara, Damasio, et al. (2000) define as the VM includes parts of the lateral orbitofrontal cortex and communicates with multiple other brain areas (Dunn et al., 2006).

Over the last several years, multiple researchers have questioned the construct validity of both the IGT and the somatic marker hypothesis, suggesting that the IGT may not be accurately described as a measure of executive functioning (Dunn et al., 2006; Steingroever, Wetzels, Horstmann, Neumann, & Wagenmakers, 2013). Of note, a recent large-scale study of adults without any known neurologic dysfunction found that measures of simple attention (e.g., Digit Span) contributed more strongly to overall IGT performance than did measures of executive functioning (e.g., the Wisconsin Card Sorting Task). Consistent with the finding from this study that measures of executive functioning predicted Phase 2 (Blocks 3-5) scores, but not Phase 1 (Blocks 1-2) scores in regression analyses, executive functioning was most robustly related to IGT performance on later blocks (Gansler, Jerram, Vannorsdall, & Schretien, 2011b). These results reflect the growing consensus that the IGT is not a uniform measure of risky decision making and that performance on earlier blocks may be served by different brain regions than later blocks (Dunn et al., 2006).

### **Decision-Making and Functional Impairment**

In the current study, there were no significant associations, direct or indirect, between decision-making task performance and self-reported functional impairment. The failure to find an association in the current study may have been due to a number of factors, including the use of a very brief measure of functional impairment, and the fact

that participants were highly educated, relatively high-functioning, and above average on measures of intellectual ability. Surprisingly few studies have attempted to link behavioral decision-making tasks to real-world functional impairments (Cunha, Bechara, de Andrade, & Nicastrì, 2011). Although the IGT has been tested on clinical samples with demonstrable functional impairment, it is unclear if this impairment is specifically associated with decision-making on the IGT. Of note, there is considerable variability even among control participants in IGT performance, with multiple studies finding that over 30% of “healthy controls” exhibit impairment (i.e., make over 50% of their selections from disadvantageous decks, comparable to the level observed in VM patients) (Steingroever et al., 2013). In fact, in the current study of highly educated, high-functioning outpatients, overall performance on the IGT varied widely, with *T* scores ranging from 24 (< 1<sup>st</sup> percentile) to 67 (96<sup>th</sup> percentile) (Bechara, 2007). Over one-quarter of the sample (28.4%; *n* = 21) performed in the range expected of VM patients. Presumably not all individuals who exhibit markedly impaired performance on the IGT display the “acquired sociopathy” described in patients with VM damage (Damasio, Tranel, & Damasio, 1990). Establishing a link between laboratory gambling tasks and real-life decision-making is particularly important given that these tasks are being used in a variety of clinical samples, many with little phenotypic resemblance to the patients for whom they were originally created.

### **Limitations and Future Directions**

Contrary to hypotheses, depression did not emerge as a significant predictor of either decision time on the MouselabWEB task or risk taking on the IGT. Results of the

current study may have been affected by the relatively low proportion of patients diagnosed with a depressive disorder. In the final sample ( $N = 74$ ), 20 participants received a clinical diagnosis of depression. Of these 20, 16 received a diagnosis of mild or moderate MDD, three exhibited subthreshold yet clinically significant symptoms of depression (and received diagnoses of MDD in partial remission or depressive disorder NOS), and one was diagnosed with dysthymic disorder. The sample did not include any participants with severe depression (as indicated by the *DSM-IV-TR* diagnostic specifier) and therefore may not have included an adequate range of depression severity. Some previous studies demonstrating significant effects of depression on decision-making have included more severely depressed patients (Murphy et al., 2001) or mood inductions that may have made depressive symptoms more salient to participants (van Randenborgh et al., 2010). The current sample's scores on the BDI-II, which ranged from 1 to 47, suggest that an adequate range of depression was represented. However, only four participants fell within the range of scores associated with "severe depression" (Beck, Steer, & Brown, 1996). Of note, the mean PSWQ score observed in the in the current study (62.62) was within the range reported in other studies of clinical mood and anxiety disorder patients (Brown, 2003; Fresco, Mennin, Heimberg, & Turk, 2003), whereas the mean OCI-R score (14.45) was lower than that reported in other clinical samples (Foa et al., 2002; Huppert et al., 2007).

The small sample size of the current study may have limited the power to detect significant relationships between variables, as well as analytic approaches used to test hypotheses. Future studies of decision-making in individuals with anxiety and mood

disorders would benefit from the use of latent variables to represent disorder constructs. The current study used self-report measures of disorder symptoms or categorical diagnoses as independent variables. The former approach acknowledged the dimensional nature of disorder features and avoided the negative statistical consequences of dichotomizing continuous variables (see Brown & Barlow, 2005), whereas the latter approach allowed for more direct comparison of results with previous decision-making studies, which have typically used diagnostic status as a unit of analysis. However, the alternating use of self-report measures of psychopathology and diagnostic status as predictors in the current study led to results that were occasionally inconsistent and therefore difficult to interpret. The use of dimensional symptom measures and consideration of the effects of comorbidity on task performance may represent advances in the nascent field of decision-making in the context of anxiety and mood disorders. A more sophisticated approach, however, would be to use multiple indicators of latent disorder factors, and to integrate these factors into structural equation models of the hypothesized relationships between disorder constructs, decision-making, and various mediators, moderators, and covariates.

### **Summary**

The current study contributes to decision science by examining two types of decision-making impairment in a mixed clinical sample, and attempting to clarify the contribution of psychopathology and cognitive functioning to decision task performance. The literatures on indecisiveness and risky decision-making have remained largely separate, despite evidence that both types of decision-making impairment are relevant to

our understanding of psychopathology. The current study was an attempt to integrate these distinct literatures and examine decision-making impairment as multidimensional construct.

Table 1

*Current Axis I Diagnoses (N = 74)*

Diagnosis	Principal or Co-Principal		Additional	
	<i>n</i>	%	<i>n</i>	%
Adjustment disorder	0	0	1	1.4
Anxiety disorder not otherwise specified	1	1.4	1	1.4
Depressive disorder not otherwise specified	0	0	1	1.4
Dysthymic disorder	0	0	1	1.4
Eating disorder not otherwise specified	0	0	1	1.4
Generalized anxiety disorder	22	29.7	14	18.9
Major depressive disorder	9	12.5	9	12.2
Obsessive-compulsive disorder	5	6.8	6	8.1
Panic disorder with or without agoraphobia	17	23.0	8	10.8
Posttraumatic stress disorder	1	1.4	1	1.4
Social phobia	26	35.1	19	25.7
Specific phobia	1	1.4	4	5.4
Trichotillomania	1	1.4	0	0

Table 2

*Sample Demographic Characteristics (N = 74)*


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Female (%)	59.5
Age (years): <i>M (SD)</i> , Range	31.8 ( <i>13.5</i> ), 18 – 70
Race (%)	
Asian/Pacific Islander	10.6
Black or African American	6.8
White or Caucasian	78.4
Other	2.7
Multiracial	2.7
Ethnicity (%)	
Hispanic or Latino	8.1
Highest Level of Education (%)	
Some high school	1.4
High school degree	2.7
Some college	28.4
Two-year degree	1.4
Four-year degree	41.9
Graduate Degree	24.3

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Table 3

<i>Performance on Neuropsychological and Decision-Making Tasks</i>	
Test	<i>M (SD)</i>
Trails A (seconds)	27.31 (7.99)
Trails B (seconds)	60.64 (21.33)
WAIS-III subtests	
Digit Symbol Coding	83.51 (13.74)
Matrix Reasoning	20.15 (3.60)
Vocabulary	52.77 (6.69)
SOC	
Number of perfect solutions	8.43 (1.81)
Initiation time (milliseconds)	6628.80 (536.62)
IGT	
Net total score	21.92 (3.67)
Total time (milliseconds)	109258.97 (58157.42)
Card selections	
Deck A	12.59 (5.60)
Deck B	26.34 (13.40)
Deck C	22.56 (12.32)
Deck D	38.49 (15.14)
MouselabWEB task (decision time and ratings averaged across decision scenarios)	
Decision time (milliseconds)	32963.49 (12986.83)
Difficulty rating	2.39 (.61)
Similarity rating	3.63 (.63)

*Note.* WAIS = Wechsler Adult Intelligence Scale. SOC = Stockings of Cambridge. IGT = Iowa Gambling Task. Prior to inclusion in analyses, decision/initiation time variables were rescaled.

Table 4

*Self-Report Measures: Means, Standard Deviations, and Correlations*

	1.	2.	3.	4.	5.	6.
1. BDI-II	1.00					
2. BIS-11	.13	1.00				
3. IS	.41**	.20	1.00			
4. OCI-R	.25*	.00	.38**	1.00		
5. PSWQ	.42**	.01	.32**	.55**	1.00	
6. SSS	.48**	.16	.17	.31**	.39**	1.00
Mean	16.39	67.21	51.26	14.45	62.62	3.44
SD	9.88	10.16	11.15	10.19	10.92	1.59

\*  $p < .05$  \*\*  $p < .01$

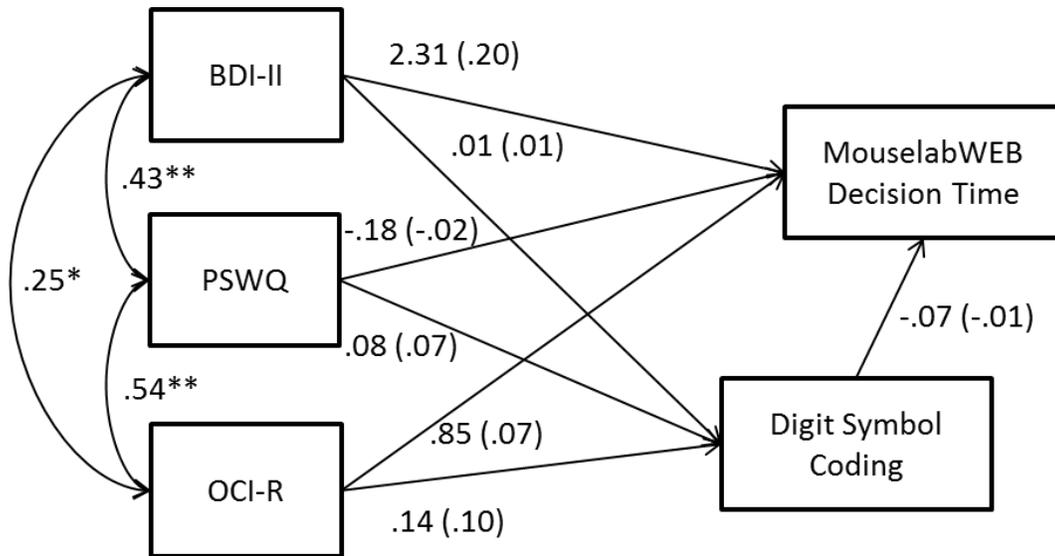


Figure 1. Path diagram of direct and indirect relationships between self-reported psychopathology, processing speed, and decision time on the MouselabWEB decision-making task. Correlation coefficients and unstandardized regression coefficients are presented, with standardized regression coefficients in parentheses. BDI-II = Beck Depression Inventory—II. PSWQ = Penn State Worry Questionnaire. OCI-R = Obsessive-Compulsive Inventory—Revised. All indirect relationships between psychopathology and decision time via processing speed were nonsignificant.  
 $* p < .05$   $** p < .01$

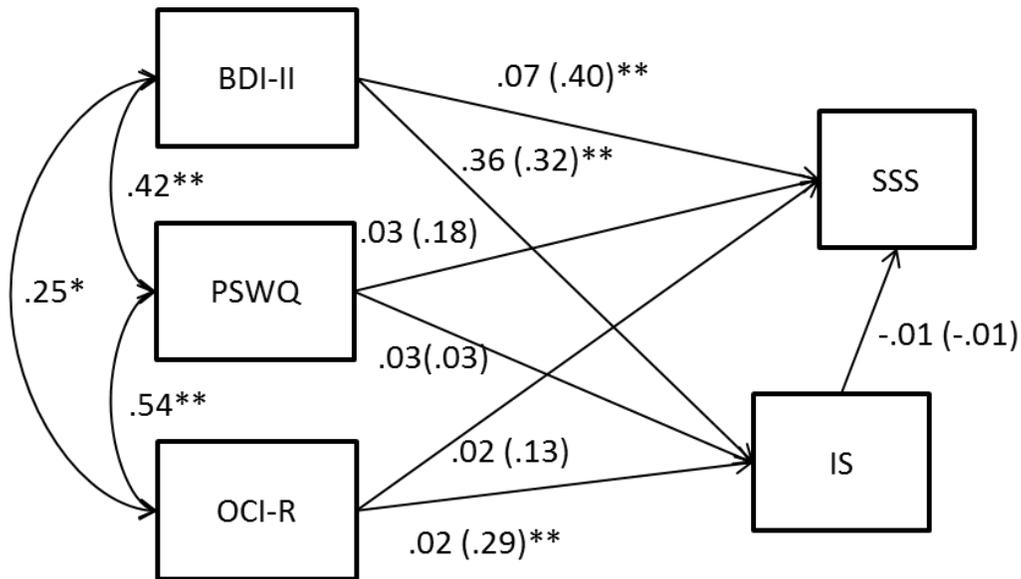


Figure 2. Path diagram of direct and indirect relationships between self-reported psychopathology, indecisiveness, and functional impairment. Correlation coefficients and unstandardized regression coefficients are presented, with standardized regression coefficients in parentheses. BDI-II = Beck Depression Inventory—II. PSWQ = Penn State Worry Questionnaire. OCI-R = Obsessive-Compulsive Inventory—Revised. IS = Indecisiveness Scale. SSS = Subjective Symptoms Scale. All indirect relationships between psychopathology and functional impairment via indecisiveness were nonsignificant.

\*  $p < .05$  \*\* $p < .01$

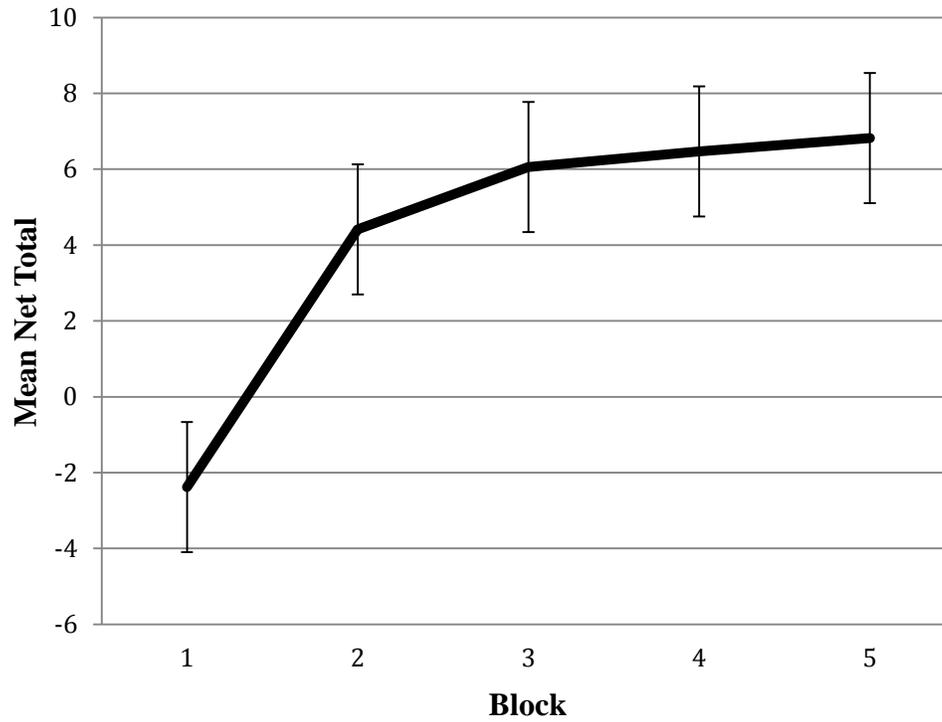


Figure 3. Performance of the full sample on the IGT. The net total is the total number of cards selected from disadvantageous decks (A and B) subtracted from the total number of cards selected from advantageous decks (C and D). Each of five blocks consisted of 20 trials.

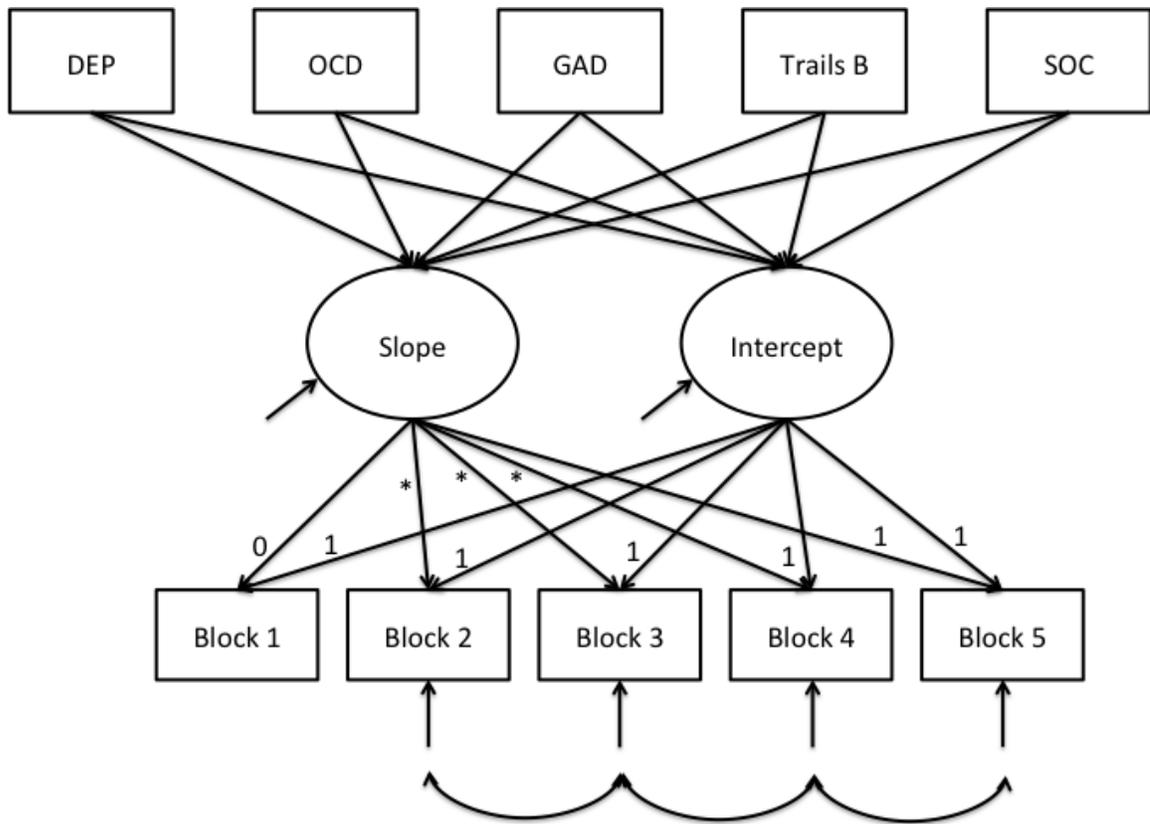


Figure 4. Conditional LGM with five covariates. DEP, OCD, GAD = categorical diagnoses representing the presence or absence of unipolar depression, OCD, and GAD, respectively. Trails B = total task completion time in seconds. SOC = total number of perfect solutions on the Stockings of Cambridge.

## **Appendix A**

### Instructions for the Iowa Gambling Task

In front of you on the screen, there are 4 decks of cards, A, B, C, and D. I want you to select one card at a time, by clicking on the card, from any deck you choose. Each time you select a card, the computer will tell you that you won some money. I don't know how much money you'll win. You will find out as we go along. Every time you win, the green bar gets bigger. Every so often, however, when you click on a card, the computer tells you that you won some money, but then it says that you lost some money too. I don't know when you will lose, or how much you will lose. You will find out as we go along. Every time you lose, the green bar gets smaller. You are absolutely free to switch from one deck to the other at any time, and as often as you wish. The goal of the game is to win as much money as possible, and if you can't win, avoid losing money as much as possible. You won't know when the game will end. You must keep on playing until the computer stops. I am going to give you this \$2000 credit, the green bar, to start the game. The red bar here is a reminder of how much money you borrowed to play the game, and how much money you have to pay back before we see how much you won or lost. It is important to know that just like in a real card game, the computer does not change the order of the cards once the game starts. You may not be able to figure out exactly when you will lose money, but the game is fair. The computer does not make you lose money at random, or make you lose money based on the last card you picked. Also, each deck contains an equal number of cards of each color, so the color of the cards does not tell you which decks are better in this game. So you must not try to figure out what the computer is doing. All I can say is that some decks are worse than the others. You may find all of them bad, but some are worse than the others. No matter how much you find yourself losing, you can still win if you stay away from the worst decks. Please treat the play money in this game as real money, and any decision on what to do with it should be made as if you were using your own money.

### Appendix B

Screen Shot of Iowa Gambling Task



## Appendix C

### Screen Shot of MouselabWEB Task

You're opening a new bank account. Which option would you choose?

	Account 3	Account 1	Account 2
Minimum Initial Deposit	<input type="text"/>	<input type="text"/>	<input type="text"/>
Interest	<input type="text"/>	<input type="text"/>	<input type="text"/>
Minimum Monthly Balance	<input type="text"/>	<input type="text"/>	<input type="text"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How difficult was it for you to make this decision?

1  Very easy      2  Somewhat easy      3  Neutral      4  Somewhat difficult      5  Very difficult

How similar did this decision feel to ones you've made in your life?

1  Very different      2  Somewhat different      3  Neutral      4  Somewhat similar      5  Very similar

**Appendix D**

## Decision Scenarios Included in MouselabWEB Task

You're buying a new computer. Which laptop would you buy?

	Laptop A	Laptop B	Laptop C
Memory	2 GB	2 GB	3 GB
Hard Drive	120 GB	160 GB	259 GB
Screen Size	15 in	18 in	14 in

You're planning to take a night course. Which one would you sign up for?

	Course 1	Course 2	Course 3
Time	5 PM	6 PM	6:30 PM
Number of Assignments	3	4	4
Number of Classes Per Week	2	3	2
Cost	\$450	\$375	\$400

You're looking for a new job. Which would be your top choice?

	Job 1	Job 2	Job 3
Salary	\$65,000	\$64,000	\$70,000
Commute	30 minutes	10 minutes	30 minutes
Opportunities for Advancement	High	Moderate	Moderate
Parking Costs	\$100/month	\$75/month	\$150/month

You're opening a bank account. Which option would you choose?

	Account 1	Account 2	Account 3
Minimum Initial Deposit	\$25	\$25	\$500
Minimum Monthly Balance	\$300	\$100	\$500
Interest	.20%	1.54%	2.28%

You're looking for a new apartment. Which one would you choose?

	Apartment 1	Apartment 2	Apartment 3
Noise Level	Low	Medium	Medium
Parking	Street	Garage	Street
Bedroom Size	12 x 12 ft	12 x 15 ft	10 x 13 ft
Length of Commute	25 minutes	30 minutes	15 minutes
Security Deposit?	Yes	No	Yes

You're buying a used car. Which car would you choose?

	Car 1	Car 2	Car 3	Car 4
Miles per Gallon of Gas	23	34	34	32
Model Year	2001	2003	2007	2005
Miles	38,000	30,000	50,000	40,000

You're buying a digital camera. Which one would you choose?

	Camera 1	Camera 2	Camera 3
Megapixels	7.1	7.2	8
Price	\$165	\$150	\$170
Screen size	3 in	2.5 in	2 in
Weight	4.4 oz	4.9 oz	5.5 oz
Length of Zoom	396 mm	360 mm	432 mm

You have several work projects to complete. Which one would you do first?

	Task 1	Task 2	Task 3
Difficulty	Low	High	Moderate
Time Requirement	40 min	60 min	40 min
Deadline	In 2 days	In 2 days	In 3 days

You and some friends are planning a social activity. What option would you choose?

	Activity 1	Activity 2	Activity 3
Approximate Length	4 hours	6 hours	3 hours
Cost per person	\$20	\$22	\$30
Number of friends invited	10	12	4

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**Curriculum Vitae**

