AN ECOLOGICAL MOMENTARY ASSESSMENT STUDY OF MOOD STATE
AND WORKING MEMORY CAPACITY IN COLLEGE STUDENTS
WHO EXPERIENCE FREQUENT MOOD FLUCTUATIONS

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Abstract

Manic, hypomanic, and depressed mood states have been shown to be associated with significant impairments in working memory capacity. Previous studies on mood state and working memory capacity have included only participants formally diagnosed with a bipolar disorder. No study has examined this relationship in persons who experience fluctuations in mood state but do not meet diagnostic criteria for a bipolar disorder. Nor have previous studies examined the relationship between mood state and working memory capacity in college students, where working memory capacity may be particularly important to academic performance. In addition, few studies of these variables have been conducted in the participants’ daily lives, rather than in laboratory settings. The goal of this study was to examine the relationships between mood state and working memory capacity in the daily lives of college students who experience frequent fluctuations in mood state. Four female and three male participants completed multiple daily mood state ratings and tests of working memory capacity using an ecological momentary assessment task. Significant relationships were observed between concurrent measures of mood state and working memory capacity for three out of seven participants. A significant relationship was also observed between time-lagged measures of mood state and working memory capacity for one out of seven participants. Finally, no relationship was observed between time-lagged measures of working memory capacity and mood state. Inferences regarding mood state and working memory capacity in college students with frequent mood fluctuations and the advantages of utilizing time-series methodology to examine mood states were discussed.
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I. Introduction

Rationale, Background, and Primary Goals

Previous studies in several different disciplines (e.g. psychology, neuropsychology, psychobiology) have reported significant relationships between persons’ mood state and their working memory capacity (which is discussed and defined on page 14). Significant correlations between mood state and working memory capacity have been reported for persons identified as clinically depressed (Lyche et al., 2011, Korsnes et al., 2013) as well as for persons who were experiencing a depressed mood state without a diagnosis of clinical depression (Leight & Ellis, 1981). In addition, significant correlations between mood state and working memory capacity have been found for persons diagnosed with Generalized Anxiety Disorder (Hayes & Hirsh, 2003), as well as persons experiencing an anxious mood state (Eysenck et al., 2007). In several non time-series studies (e.g., Malhi et al., 1994; Malhi et al., 1997; Levy et al., 2011) measures of persons’ depressed or manic mood states were reported to be negatively correlated with measures of working memory capacity, as compared to persons in a euthymic mood state. The majority of the studies that examined mood state and working memory capacity were conducted with persons diagnosed with Bipolar Disorder.

To date, there have been few studies that have examined the relationships between manic and hypomanic mood states and working memory capacity. Manic and hypomanic mood states may have significant linear, nonlinear, positive, or negative functional relationships with the academic performance of university students. In addition, there may be significant individual differences in the relationship between
different mood states and working memory capacity. Further, the majority of working memory capacity studies have been conducted in laboratory settings and few studies have examined these individual differences in a naturalistic setting. The goal of the current study was to examine the relationships between mood states and working memory capacity in university students, using ecological momentary assessment in multivariate time-series assessment strategies implemented in the participant’s natural environment.

In this study, mood states were measured multiple times within and across days in order to examine their association with working memory capacity for university students who experience significant cycling across mood states (hypomanic, manic, or depressed mood states) within or between days. The following sections review research that has examined the relationships between working memory capacity and mood state.

Mood States and Associated Functional Impairment

Manic Mood State. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5)(APA, 2013, p.124) defines a manic mood state\(^1\) as: “a distinct period of abnormally and persistently elevated, expansive or irritable mood, accompanied by persistently increased activity or energy levels; during which three of the following have persisted: inflated self-esteem or grandiosity, decreased need for sleep, more talkative than usual or pressure to keep talking, flight of ideas or subjective experience that

\(^1\)“Mood state” and “episode” are often used interchangeably in the literature; i.e. authors in the mood and memory assessment literature often use “manic mood state” when referring to an “episode” as strictly defined by DSM-5 in the Mood Disorders section (the difference is that a strictly defined manic episode must last at least 1 week, while a mood state does not have a specific duration criterion). Due to the subject of this manuscript, “mood state” will similarly be used throughout.
thoughts are racing, distractibility, increase in goal-directed activity, and excessive involvement in pleasurable activities that have a high potential for painful consequences. In addition, there is marked impairment in social or occupational functioning during this period."² Approximately 1-1.5 % of the general population experience manic mood states (DSM-5, APA, 2013). About 1.5-1.7% of college students are treated at counseling centers for manic mood states, throughout all years in college (Merikangas et al, 2011).

Studies have found significant associations between manic mood states (often called ‘manic episodes’ in the Bipolar Disorder literature) and impairment in (a) work, (b) cognitive functioning, and (c) overall psychological functioning (Reed & Goetz, 2010, Adida, Clark & Pomietto, 2003; Blaney, 1996). (Cognitive impairment associated with manic mood states will be discussed in greater detail in a later section).

A study by Reed and Goetz (2010) found a significant association between mood state and occupational impairment. This study classified 28% and 68% of persons diagnosed with Bipolar Disorder who were experiencing a manic mood state as having ‘low’ and ‘high’ occupational impairment, respectively. The study found that the experience of a manic mood state within the past 12 months was significantly associated with having “high” occupational impairment (Adjusted Odds Ratio=1.4, p<.0001, 95% CI).

The effects of even one manic mood state experienced over a period of days can be long lasting. In a 4-year follow-up of 75 hospitalized patients with a first instance of a

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² As previously mentioned, the duration criteria for a manic episode is “1 week” in DSM-5. This criterion was not used for the current study because the emphasis was on persons who experience more frequent mood fluctuations.
manic mood state, 70% had experienced significant impairment in either occupational or social functioning for at least six months during the past 4 years (Tohen, Waternaux & Tsuang, 1990).

Hypomanic Mood State. The DSM-5 (APA, 2013, p.124) defines a hypomanic mood state as follows: “A period of persistently elevated mood, accompanied by persistently increased activity or energy levels, during which three (or more) of the following symptoms have persisted: inflated self-esteem, decreased need for sleep, more talkative than usual, flight of ideas, distractibility, increase in goal-directed activities, or excessive involvement in pleasurable activities that have a high potential for painful consequences. In addition, the mood disturbance is not severe enough to cause marked impairment in social or occupational functioning” (DSM-5, APA, 2013). No studies were located that examined the prevalence rates of hypomanic mood states in college students.

There is evidence to suggest that persons experiencing hypomanic mood states also experience various types of functional impairment, such as problems focusing or maintaining attention, although the degree of impairment associated with hypomanic mood states is often less than that of manic mood states (Tohen et al., 1990). In one study, the Global Assessment of Functioning scale of the DSM-IV-TR (GAF; APA, 1994) and a battery of working memory capacity tests were given to patients with Bipolar disorder who were either in a manic, hypomanic, or depressed mood state, as well as healthy controls. GAF scores were significantly lower for patients in a hypomanic mood state than for healthy controls (T=11.39, P=0.001) (Malhi et al., 2007).
Depressed Mood State. Persons who frequently experience hypomanic or manic mood states often experience depressed mood states as well. The DSM-5 (APA, 2013, p.125) defines a depressed mood state as: “Five (or more) of the following symptoms: depressed mood, markedly diminished interest or pleasure in activities, significant weight loss or weight gain, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue, feelings of worthlessness, diminished ability to concentrate, recurrent thoughts of death, recurrent suicidal ideation or a specific plan for committing suicide.”

Approximately 40% of students who present at college counseling centers (approximately 5.6% of the total student population) are treated for depressed mood states throughout all years in college. Studies suggest that depressed mood states are reported more frequently than manic mood states in university students who seek counseling (Rimmer, 2007).

Depressed mood states have also been shown to be associated with elevated levels of functional impairment. One study, using a questionnaire and cross-sectional design, reported that even ‘modest’ increases in the severity of depression symptoms as measured by the Beck Depression Inventory (Beck & Steer, 1986) were associated with statistically and clinically significant increases in functional impairment and disability (Simon et al., 2007). In addition, Malhi et al. (2007) found that patients who were currently experiencing a depressed mood state had a significantly lower GAF score compared to patients without a mood disorder (T=-2.86, P=.01).

Euthymic Mood State. In the Bipolar Disorder literature, an individual who has been diagnosed with a Bipolar Disorder, who is not experiencing symptoms of Bipolar Disorder may be referred to as experiencing a “euthymic mood state.” This is a fairly new

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3 The authors did not report the degrees of freedom in the manuscript for this statistic.
area of research and the results have been inconsistent among about a dozen studies that have examined the associations between euthymic mood states and functional impairment. A study by Malhi et al. (2007) found that persons diagnosed with Bipolar Disorder who were experiencing a euthymic mood state experienced significantly less functional impairment than those experiencing a depressed, manic, or hypomanic mood state (see Appendix A). However, other studies (Basso et al., 2009; Basso et al., 2004) suggested that persons diagnosed with Bipolar Disorder who were experiencing a euthymic mood state performed worse than controls on certain measures of neuropsychological functioning (this will be discussed in detail in a later section).

Bipolar Disorders. Bipolar Disorders are characterized by recurring manic mood states that are often followed by hypomanic or depressed mood states (DSM-5, 2013). Prevalence rates for Bipolar Disorders in the U.S. are about 1-1.5% (DSM-5, APA, 2013) and some deficits in working memory capacity may occur across mood states in persons diagnosed with Bipolar Disorder. A study by Muesel et al. (2013) showed significant deficits in a working memory capacity task for all participants with Bipolar Disorder, regardless of mood state, compared with healthy controls (F(1,47)=4.87, P=.03).

Summary. Research findings suggest that functional impairment often co-occurs with depressive and manic mood state and to a lesser degree in hypomanic and euthymic mood states. Several limitations reduce confidence in the results of these studies and the inferences that can be drawn about the relationships between mood states and functional impairment. First, idiographic time-series designs have not been used to investigate the relationships between manic mood states and functional impairment. Idiographic time-series designs involve frequent measurements to assess change in, and the time-related
relationships among, dependent and independent variables for a person (Gottman, 1969). Time-series designs may help identify significant relationships between mood states and functional impairments in a naturalistic setting and the temporal aspects of those relationships. In addition, mood states are dynamic--they fluctuate across time. None of the aforementioned studies collected daily measures of functional impairment associated with different mood states or measured mood states at a rate that would enable a sensitive measure of their time-course. Lastly, few studies have examined the relationship between cognitive functioning and hypomanic mood states, especially hypomanic mood states.

_The Measurement of Mood State_

Most of the strategies for measuring mood state have used trait-based, retrospective self-report questionnaires, administered to participants one or a few times and are unsuitable for capturing the dynamic nature of mood within and across days (Blaney, 1986; Matt & Vazquez, 1992; Wenze & Miller, 2010). In order to assess how working memory changes as a function of mood states, it is important to measure mood with strategies that provide data that are both valid and sensitive-to-change. Previous studies have typically used self-report questionnaires that ask the participant to report their moods retrospectively, for example, for the past two weeks. Retrospective recall of mood has been shown to be significantly influenced by current mood state, and thus may not accurately reflect previous mood state (Wenze et al., 2010). In addition, mood ratings obtained in an analog laboratory environment, the assessment setting used in most studies, may not generalize to naturalistic settings such as the home or school (Wenze et al., 2010). Research suggests that recall of mood can also be confounded by several other
factors, such as beliefs about self and others, and externalizing/internalizing cognitive styles (Ben-Zeev et al., 2009).

Ecological Momentary Assessment of Mood. One recently validated method to assess mood is through the use of mood ratings that are collected momentarily in order to reduce the impact of errors associated with retrospective recall (Wenze & Miller, 2010). This assessment methodology, known as Ecological Momentary Assessment (EMA), involves repeated momentary sampling of participants’ current behaviors and experiences in real time, most often in participants’ natural environments. EMA has been used in the assessment of mood, eating, smoking, substance use, exercise, and other types of human behavior (see Ebner-Priemer et al., 2009, for a review). One of the most commonly used methods of EMA involves the use of a Personal Digital Assistant (PDA) (or more recently, a Smartphone) that enables participants to provide data on multiple variables quickly and in their natural environment.

EMA has been used to assess mood in studies that involve persons who experience depression and anxious symptoms; as well as persons diagnosed with persistent disorders such as Schizophrenia and Bipolar Disorder (for a review on EMA and measuring mood, see Schiffman et al., 2008). It has also been used to examine how momentary stress can influence subsequent mood (South & Miller, 2013), for gathering data on cognitive functioning by presenting cognitive tasks, such as the Temporal Order Judgment Task (Vibell et al., 2007), as well as the Tower of London Task (Shallice et al., 1982), and in studies that track changes in neurological functioning over time, such as with post-concussive brain injury symptoms (Lewandowski et al., 2009). However, we located no studies in which EMA was used to study working memory capacity.
Working Memory Capacity: An Overview

There have been many definitions of “working memory capacity.” The first dates back to the cognitive model of memory proposed by Baddeley and Hitch (1974) in which working memory was considered a short-term storage system for new information. Cognitive scientists have recently redefined the properties of working memory capacity and it is now considered as a general reserve of ecological cognitive functioning. (Engle, Kane & Tuholski, cited in Miyake & Shah, 1999). It has been operationally defined by Engle as “the ability to maintain and access information in the context where stimuli compete for a person’s attention” (Engle, 2010, p.517). The definition by Engle is well accepted in the field and informs the measurement procedures used in this study.

Working memory capacity has been shown to be significantly associated with measures of reasoning, problem solving, inferential abilities, reading and writing, and social perception (Rosen & Engel, 1997). Although it remains fairly stable across time, it can be affected by Alzheimer’s disease, frontal lobe damage and alcoholism (Conway, 2005). Working memory capacity was also shown to be significantly associated with the ability to process verbal feedback during an instructional task in children of various ages (Fyfe, DeCaro & Rittle-Johnson, 2014).

Use of Working Memory Capacity Measures: Limitations. The neuropsychological tests included in meta-analyses of working memory capacity often do not measure the construct of “working memory capacity” in the same way. This is illustrated by the fact that working memory capacity assessed by the Raven’s Progressive Matrices and long-term memory assessed by the National Adult Reading Test are sometimes aggregated into one non-specific ‘memory variable’ (Basso et al., 2009).
Thus, it is sometimes difficult to draw conclusions about the relationships between working memory capacity and mood states because working memory capacity measures are often integrated with other measures of memory, attention, and cognitive performance as an aggregated measure of “cognitive functioning.”

Measuring Working Memory Capacity. Three recent instruments developed by Engle and colleagues have been frequently used to measure working memory capacity. These include: the Reading Span Task (Rspan), the Operation-Span Task (Ospan) and the Counting Span Task. These three tasks were originally developed as pen-and-paper tasks, and have now been computerized. Conway (2005) summarized research on the validity and reliability of these three tasks and found that the task with the highest validity indices was the Ospan Task, which was selected for use in this study.

In the Ospan task, developed by Turner and Engle in 1989, participants have to solve a series of arithmetic operations that are then followed by words, (e.g. 9/3 + 5 = 4; “Job”). Participants are asked to remember the words after answering whether the operations are true or false. The arithmetic operations and the words in the Ospan task compete for the participant’s attention, are consistent with Engle's operational definition of working memory capacity (Engle, 2010), and are adopted for this study. (See “Methods Section” for validity, reliability, and an in-depth explanation of the Ospan.)

Working Memory Capacity and Mood State

Depressed Mood State. As illustrated in Appendix A, several studies have found a significant association between working memory capacity and depressed mood states. Harvey (2004) found that working memory capacity was significantly lower for participants who reported higher levels of depressed mood, compared to healthy controls.
Research has also suggested that performance deficits on various cognitive tasks that include working memory capacity are significantly correlated with the severity of participant's depressed mood states (see Mitchell & Phillips, 2007, for a review). One study found that depressed mood states were associated with working memory capacity deficits on an “n-back” task at the time of assessment and after a 24-hour delay, compared to the task performance of a control group who showed no working memory deficits (F(1,97)=19.46, P<.001) (Curci, Lanciano & Soleti, 2013).

Manic Mood States. The results of several studies have suggested that working memory capacity deficits may be significantly positively correlated with measures of manic mood states. Goldberg and Chengappa (2009), in a review of several studies, reported that deficits in working memory capacity were associated with manic episodes in persons diagnosed with Bipolar Disorder. The findings of one study indicated that subjects who experienced a manic mood state at the time of sampling performed significantly worse than controls on measures of working memory capacity and planning (F=21.7, P<.0001)4 (Adida, Clark & Pomietto et al., 2008, see Appendix A). It should be noted that baseline measures of working memory capacity for the patients (or control participants) were not obtained, a limitation in the research that is also applicable to other studies.

In the Malhi et al. study (2007), working memory capacity was measured in persons diagnosed with Bipolar Disorder who were experiencing euthymic, depressed, manic or hypomanic mood states. Patients who were experiencing a manic mood state performed significantly worse on a working memory capacity task than patients

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4 The degrees of freedom were not reported by the authors in this manuscript.
experiencing a hypomanic mood state, and both performed significantly worse than healthy controls (see Appendix A for all significant results of this study).

Hypomanic Mood State. Some studies suggest that hypomanic mood states are also positively correlated with working memory capacity deficits, but that these associations are significantly weaker than those found in manic or depressed mood states. For example, in the Malhi et al study (2007) subjects, who experienced a hypomanic mood state at the time of sampling showed working memory capacity deficits, compared to controls.\(^5\) Martinez-Aran et al. (2004) found that hypomanic patients performed significantly worse than controls on a verbal working memory capacity test (F(15,46)=3.12, P=.002). In addition, one study found that working memory capacity during a depressed mood state was significantly decreased if the participant had also experienced brief hypomanic mood states in the past 12 months, compared to participants who had experienced only depressed mood states in the past 12 months (F(2,65)=6.044, p<.005) (Korsnes et al., 2013). Additional research is needed to examine the relationship between hypomanic mood states and working memory capacity.

Euthymic Mood State. The few studies that have examined the potential relationships between euthymic mood states and working memory capacity have not found significant relationships between measures of these two constructs. In several longitudinal studies of persons experiencing different mood states, working memory capacity deficits observed in a depressed or manic mood state returned to “normal” (i.e. the same as a healthy control subject) in a euthymic mood state (see Olley et al., 2005, for

\(^5\) The authors reported the results as “(T=2.14, P=.06)” and this was described as “approaching significance.”
a review). Interestingly, when mood states were induced for a non-clinical population, one study found that the “neutral” participant group recalled less than the “happy” and “sad” on a task measuring retrieval of a list of ten words. (F(4,45)=19.14, p< .01) (Philpot & Madonna, 1993). Overall, research in this area remains inconclusive.

Summary. The results of several studies suggest that manic and depressed mood states are more strongly associated with working memory impairments than are hypomanic or euthymic mood states. In addition, some have argued that a hypomanic mood state may improve attention, and thus, working memory capacity. Other research has found that working memory capacity impairments are not significantly associated with euthymic mood states. Given discrepant findings on mood state and working memory capacity, more research is needed. In addition, temporal aspects of these relationships between mood state and working memory have not been examined. These dynamic associations can be more readily examined through multivariate time-series regression procedures using ecological momentary assessment.

Relevance for College Students’ Performance

Working memory capacity deficits associated with elevated and depressed mood states may pose particular problems for college students, who encounter frequent situations that require a high degree of working memory capacity (e.g. academic tests, presentations, classroom discussions). Despite its importance, the degree to which manic or hypomanic mood states might influence working memory capacity has not yet been examined in college students.

Specific Goals of the Study

The goals of the current study were to use EMA with college students who report
frequent fluctuations in mood states to examine the degree to which:

(1) variance in working memory capacity can be accounted for by variance in time-lagged measures of mood state.

(2) variance in working memory capacity can be accounted for by concurrent measures of mood state.

(3) variance in working memory capacity can be accounted for by concurrent measures of mood state above and beyond that of previous working memory capacity measurements (if significant variance in working memory capacity is shown to be accounted for by concurrent measures of mood state).

(4) variance in mood state can be accounted for by previous working memory capacity measurements.
II. Methods

Participants

Demographic Characteristics and Self-Reported Mood State Descriptions: The participants consisted of four female and three male students, ranging in age from 23-38 years old, who were receiving counseling services at CSDC. Data on mood fluctuations at the initial assessment session included self-report data regarding mood states from the Beck Depression Inventory-II (BDI-II), Young Mania Rating Scale (YMRS), and the Standard Clinical Interview for DSM-IV Disorders- Clinician Version (SCID-CV) (see Table 1 for these data).

According to data from the BDI-II and YMRS, at the initial assessment session, two participants (Ppt. #2 and Ppt. #6) were experiencing a depressed mood state, none of the participants were experiencing a manic mood state, and two participants (Ppt. #3 and Ppt. #4) were experiencing a hypomanic mood state.

According to data from the SCID-CV, four participants (Ppts. #1, #2, #5, #6) experienced depressed mood states more commonly than hypomanic mood states, with the reverse being true for two participants (Ppt. #3 and #4). Only one participant (Ppt. #3) commonly experienced manic mood states. Five of the participants (Ppts. #1, #2, #3, #5, and #6) had mood states that lasted longer than three days on average, whereas two participants (Ppts. #4 and #7) had mood states that tended to be of shorter duration. Three of the participants (Ppts. #1, #2, and #3) were taking antidepressant medication during the

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6 See “Assessment Instruments and Measures” subsection for a description of these assessment instruments.
study. One participant (Ppt. #4) was taking a mood stabilizing medication during the study.

Table 1.

*Participant Demographics and Mood Data*

<table>
<thead>
<tr>
<th>Ppt.</th>
<th>Sex</th>
<th>Age</th>
<th>BDI-II Score&lt;sup&gt;a&lt;/sup&gt;</th>
<th>YMRS Score&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Type of Mood State</th>
<th>Average Duration of Most Commonly Experienced Mood State&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Duration of Other Mood State(s)&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>29</td>
<td>9</td>
<td>5</td>
<td>Depressed</td>
<td>3–4 days, once every 2 weeks</td>
<td>2 days every month (hypomanic)</td>
<td>Celaxa</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>38</td>
<td>24</td>
<td>2</td>
<td>Depressed</td>
<td>3–4 days once every week</td>
<td>1–2 days every 2 weeks (hypomanic)</td>
<td>Celaxa</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>33</td>
<td>10</td>
<td>14</td>
<td>Hypomanic</td>
<td>3–4 days once every week</td>
<td>2 days every two weeks month (depressed), one day a month (manic)</td>
<td>Wellbutrin</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>26</td>
<td>4</td>
<td>12</td>
<td>Hypomanic</td>
<td>2–4 days every 2 weeks</td>
<td>3 days every 2 weeks (depressed)</td>
<td>Lithium</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>23</td>
<td>2</td>
<td>3</td>
<td>Depressed</td>
<td>3–4 days every week</td>
<td>1 day every week (hypomanic)</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>28</td>
<td>32</td>
<td>0</td>
<td>Depressed</td>
<td>4 days every 2 weeks</td>
<td>2 days every month (hypomanic)</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>Female</td>
<td>25</td>
<td>15</td>
<td>5</td>
<td>Hypomanic</td>
<td>2 days every week</td>
<td>1 day every week (depressed)</td>
<td>None</td>
</tr>
</tbody>
</table>

<sup>a</sup>=Beck Depression Inventory-II score at initial assessment. 0–9: indicates minimal depression, 10–18: indicates mild depression, 19–29: indicates moderate depression, and 30–63: indicates severe depression.

<sup>b</sup>=Young Mania Rating Scale score at initial assessment. Scores of 14 or higher are associated with manic or clinically meaningful hypomanic episodes; higher scores indicate more severe episodes of mania.

<sup>c</sup>=data provided by the Structured Clinical Interview- Clinician Version at initial assessment
Inclusion and Exclusion Criteria. Inclusion criteria were: (a) students from the University of Hawai‘i, Mānoa (b) current CSDC clients (c) between the ages of 18 and 60, (d) English speakers (e) referred by their counselors and (f) experiencing frequent significant mood fluctuations across 2-4 days during the recruitment process (more information on this criterion will be provided later). Exclusion criteria were: a) symptoms of psychosis or thought disorder reported by the referring counselor or from the SCID-CV, b) symptoms of current suicidality as indicated by students’ responses of "2" or greater to Item 9 on the BDI-II and/or reported by the referring counselor, and c) no recent (within one month) history of cocaine, methamphetamine or ecstasy use; and no intent to use within a 2-month period reported by the referring counselor and/or from the SCID-CV diagnostic interview.

Procedures

Initial Contact with Treatment Providers. The principal investigator met with interested treatment providers at CSDC to explain and answer questions about the project. The principal investigator gave a brief demonstration of the study’s measurement program using a PDA (see Appendix C for the demonstration outline). After the demonstration, treatment providers were asked if they had clients who they were considering for the study and were given written information about the recruitment process (see Appendix D for further treatment provider information). Appropriate referral forms were left for the providers to return in envelopes that were stamped and addressed to the principal investigator’s office (forms described below).

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7 See PDA: Instruments, Measures, and Measurement Procedure subsection for a description of the program.
Treatment Provider Recruitment of Students. Treatment Providers briefly explained the study to individual students and asked students if they would be interested in participating. If the student expressed an interest, treatment providers completed a Referral Form while the student was present (see Appendix E). This form contained a checklist of the inclusion and exclusion criteria. Treatment providers were familiar with the degree of mood fluctuations of the majority of the potential participants. In the few cases in which they were not, treatment providers asked potential participants the following screening question: “How often do you experience significant changes in mood, e.g., having an extremely elevated mood and then an extremely low mood or vice versa? More than once per day, once every day or two, more than once per week, or less than once per week?” If potential participants experienced significant changes in mood at least once per week, treatment providers asked them to sign the Permission Form, which allowed the principal investigator to contact them about the study (see Appendix F). Treatment providers mailed the Referral Form, and Permission Form to the principal investigator’s office.

Initial Phone Contact. The principal investigator contacted potential participants on the phone once the referral forms were received (see Appendix G for a full description of the initial phone contact). The principal investigator briefly discussed the study and inquired about mood fluctuations experienced by potential participants to determine eligibility. The participants were scheduled for an initial assessment session with the principal investigator if they met inclusion and exclusion criteria and verbally consented to participate in the assessment battery. No potential participants refused to participate.
Initial Appointment: Formal Consent to Assessment, Assessment, Study Explanation, and Informed Consent Process. Potential participants met with the principal investigator individually in the principle investigator’s office, where the study was explained, any questions were answered, and the Consent to Assessment Form (see Appendix H) was reviewed. If potential participants agreed to participate in the initial assessment, they were asked to sign the Consent to Assessment form and the principal investigator proceeded with the initial assessment. The initial assessment included: (a) the same screening question asked by the treatment providers (see above), (b) the SCID-CV, (c) the BDI-II and (d) the YMRS (see Table 1 for data on mood fluctuations). If potential participants met the inclusion and exclusion criteria, the principal investigator proceeded with an explanation of the study and the informed consent process. All potential participants met the inclusion and exclusion criteria\(^8\).

The principle investigator showed the PDA to potential participants and explained: (a) the basics of its operation, (b) time sampling strategies, (c) the need for weekly meetings to download the data, (d) the duration of the study, and (e) compensation (see Appendix I for an outline of this conversation). Potential participants were then able to ask any questions about the study.

Next, the Informed Consent form was reviewed with potential participants (see appendix J.) If they agreed, they were asked to sign the Informed Consent Form and they became study participants. The principal investigator provided them with compensation\(^9\).

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\(^8\) This is likely because (a) the treatment providers already knew the criteria before referring and (b) the subject pool was small.

\(^9\) The compensation for assessment was a $10 Starbucks card.
and proceeded with PDA training.

PDA Training. First, participants were given a written Training Guide to reference during this training (see Appendix K for the PDA Training Guide). Next, the principal investigator gave participants a study ID and each participant went through a “test run” to show how to complete the data collection measures on the PDA. The principal investigator demonstrated, and the participants practiced, the measurement process: (a) a notification prompt sounded on the PDA, (b) participants went to the start menu on the PDA to open the measurement program, and (c) participants completed the measurement program (described in detail later). The principal investigator then created a scheduling sheet (see Appendix L) around which the participants’ notification prompts were programmed. The prompts were programmed to sound 3 times daily, with a minimum of 4 hours and a maximum of six hours between prompts. If participants had times during which they could not be notified to complete the measures, such as sleeping or class times, these were entered into the scheduling sheet. Next, notification prompts were programmed into the PDA by the principal investigator. Timely responding to notification prompts was emphasized. Participants were notified that adherence would be checked at weekly follow-up appointments. In addition, they were informed that the PDA would be charged during these weekly follow-up appointments and that their data would be “Hot Synced” into a computer database during the weekly appointment. Participants were encouraged to call the principal investigator if they had any questions about using the PDA. A time was then set for the first weekly follow-up appointment. Lastly, participants were given the PDA and thanked for their time.

Subsequent Contacts with Participants. The next day, the principal investigator
contacted each participant by phone for troubleshooting (see Appendix M for an outline of this contact). After this phone contact, the next contact was the weekly follow-up appointment. During this appointment, participants’ data was “Hot Synced” into the database as described above and the next follow-up appointment was scheduled. Weekly appointments continued as described for six weeks until completion of the study.\textsuperscript{10} Participants were paid $25 weekly for their participation in the study.\textsuperscript{11}

\textit{Assessment Instruments and Measures}

The initial assessment battery had two purposes: (a) to ascertain if participants meet inclusion and exclusion criteria and (b) to evaluate their self-reported depressed, manic, or hypomanic mood states and the duration of such mood states.

Mood Fluctuation Screening Question. To furnish information about inclusion criteria, each potential participant was asked, “How often do you experience significant changes in mood?” Further prompts about mood state changes were administered to two participants (see Appendix N).\textsuperscript{12}

\textsuperscript{10} Participant #7 was not able to finish six consecutive weeks in the study due to a travel commitment. Only four weeks of her data were collected and analyzed.

\textsuperscript{11} All participants, with the exception of Participant #7, were paid $150 at the completion of the study. Participant #7 was paid $100 at the completion of the study.

\textsuperscript{12} If participants only rapidly cycled between manic mood state and depressed mood states within a single day, they were not included in the study. This is sometimes considered a sign of Borderline Personality Disorder, which was beyond the scope of the study. One potential participant was excluded on this basis.
Structured Clinical Interview for DSM-IV (Clinician Version) (SCID-CV). The SCID-CV is a structured diagnostic interview with six self-contained modules that are used to assess for psychiatric symptoms. It is one of the most widely used diagnostic interviews (First, Spitzer, Gibbon & Williams et al., 1997). Research on earlier versions of the SCID demonstrated adequate test-retest reliability, with kappas ranging from .70 to 1.0 (Strakowski et al., 1993, Stukenberg et al., 1990). In terms of validity, there have been few studies conducted on the SCID-CV, as the SCID is often used as the “gold standard” in studies validating other assessment instruments. The modules that were administered were the Substance Use module (see Appendix 0) and the Mood Disorders module (see Appendix P). The purpose of the SCID-CV was to furnish information about exclusion criteria and to characterize potential depressed or manic/hypomanic mood states.

Young Mania Rating Scale (YMRS). The YMRS is a clinician rating scale, which is used to assess current manic mood state symptoms (see Appendix Q). The scale contains 11 items that are rated from 0 (normal behavior) to 4 (extreme deviance). Total scores range from 0 to 60. Higher scores on the YMRS indicate greater symptom severity. The purpose of the YMRS in assessment was to define the degree to which a student was experiencing an elevated mood state.

Inter-rater reliability for the total (r = 0.93) and item-level scores (r ranged from 0.66 to 0.92) was adequate, according to a large-scale study of depressed participants (Young et al, 1978). Convergent validity was also found to be adequate, with correlations from three clinician rated mania scales ranging from Cronbach's $\alpha = 0.71$ to 0.89 (Young et al, 1978). The YMRS is considered to be the “gold standard” for measuring manic
mood state symptoms in clinical trials (Youngstrom et al., 2003).

Beck Depression Inventory (BDI-II). The BDI-II is a self-report inventory that assesses the severity of depressed mood states (see Appendix R). It contains 21 items that are rated on a 0-3 scale, with summary scores ranging between 0 and 63. A score of 0-9 has been assumed to indicate minimal depression, 10-18 mild depression, 19-29 moderate depression, and 30-63 severe depression. The purpose of the BDI-II was (a) to assess the degree to which a student was experiencing a depressed mood state, and (b) if the student had current suicidal ideation.\(^\text{13}\)

The BDI-II has been shown to have adequate internal consistency, and hundreds of studies have supported its validity (see Hunsley & Mash, 2008, chapter 8, for a review). For example, one study demonstrated Cronbach's $\alpha=93$ for college students and .92 among outpatients (Beck et al., 1996). Another study demonstrated Cronbach’s $\alpha= .87$ and .90 at pre and post-treatment for depressed psychiatric patents, respectively (Titov et al., 2011).

**PDA: Instruments, Measures, and Measurement Procedure**

(1) Internal States Scale (ISS). The ISS is a self-report instrument that assesses mood state. The purpose of the ISS was to measure the degree to which a participant was experiencing a manic or depressed mood state at the time of sampling. The original ISS used a visual analogue format in which participants indicate mood state by marking their position on fifteen 100-mm lines, which represented different aspects of mood state (ex: “I am feeling like nothing will work out today”) (see appendix S). Scores were computed for four empirically derived subscales (Activation, Well-being, Perceived Conflict, and

\(^{13}\) If students endorse a “2” or higher on item 9, they will be excluded from the study.
Depression) and allowed for assessment of both manic and depressed mood states.

The ISS has been shown to have good internal consistency, with Cronbach's alphas that range from $\alpha=.81$ to $\alpha=.92$ for the subscales (Bauer, Chrits-Christoph & Ball, 1991). The ISS has also been shown to have good discriminative validity, in distinguishing significantly between psychiatric patients with mood disorders and "normal" participants (Bauer et al., 1991). In a public sector sample of veterans with Bipolar Disorder, the ISS showed moderate agreement with physician ratings of mood state ($k=.56$) (Bauer et al., 2000).

Modification of ISS for PDA: The ISS’s response format was modified to have a drop-down menu on the PDA indicating the degree to which participants endorsed each mood rating from 0-100 than the horizontal lines mentioned above (see appendix S). The other modification involved participants picked the answer using the stylus (writing apparatus) on the PDA.

(2). Operation Span Task (Ospan). The Automated Ospan task is now one of the “gold standard measurements” for working memory capacity (Oberaurer, in Welhelm & Engle, 2005). It has been shown to have adequate internal consistency, with split-half correlation coefficients demonstrated in the range of $.70-.90$ (Conway et al., 2005). In adults, the Automated Ospan was demonstrated to have test-retest correlations of approximately $.78-.80$ at 3 months (Klein & Fiss, 1999). In terms of convergent validity (with samples of adults and children of average intelligence), operation span tasks have been shown to significantly correlate with a wide range of higher order cognitive tasks, such as reading and listening comprehension, language comprehension, following oral and spatial directions, vocabulary learning, and complex learning (Daneman & Merikle,
These findings suggest that the central construct measured by the Automated Ospan is working memory capacity, as defined by “the ability to maintain and access information in the context where stimuli compete for a person’s attention” (Engle, 2010).

Modifications of Automated Ospan Task and scoring for PDA. Several changes were made to the Automated Ospan to enable its application and scoring with a PDA: (a) the PDA’s Automated Ospan program (contained within the measurement program, described below) presented ten arithmetic operations and ten words at a time during each measurement period\(^{14}\), (b) participants only had to recall the words, not word order, and (c) the signals (PDA “alarms”) were programmed at different times every week due to differences in participants’ daily schedules. Due to the high frequency of arithmetic operations presented during each trial in this study (10 arithmetic problems presented each time), responses to the Ospan were scored according to total number of words remembered regardless of order.

Measurement of Mood State and WMC on the PDA. Measurement of mood state and working memory capacity occurred as follows\(^{15}\): (a) a notification alarm sounded on the PDA, (b) the participant opened the “Thinking and Feeling” task (which contained the ISS and Automated Ospan), (c) the participant read the ISS instructions and hit “begin,” (d) the participant answered all ISS items with regards to their current mood state, (e) following the last ISS item, the Automated Ospan opening screen displayed on

\(^{14}\) The 3-letter words and arithmetic expressions were generated randomly from an internal file of 1000 expressions and words.

\(^{15}\) Participants were trained by the principal investigator to perform the “Thinking and Feeling” task before data collection began (as mentioned in “Procedures” section).
the PDA, (f) the participant read the Automated Ospan instructions and hit “begin,” (g) the Ospan presented a arithmetic operation, (h) the participant clicked “yes” or “no” in response to the accuracy of the arithmetic expression (i.e. “6+ (4/2)=8, ‘Yes?’/ ‘No?’”), (i) the participant saw a three letter word flash on the screen (i.e. “dog”), (k) this process repeated ten times, and (j) the participants typed as many words as they could recall on ten blank lines on the final screen of the Ospan, using the pop-up keyboard and the stylus of the PDA (i.e. “dog,” “cat,” “pan,” etc.)(see Appendix U for screen shots of the “Thinking and Feeling” task). Participants had a fifteen-minute window with which to complete the entire “Thinking and Feeling” task.

Data Reduction and Measures

Measurement of Mood State. Because there was no precedent for deriving measures of mood state from EMA measurement strategies with the ISS, some aspects of mood states scoring were exploratory. Different categorical and continuous measures of mood state were used in different combinations in order to examine the functional relations between these measures (of depressed, manic, hypomanic and mixed mood states) with working memory capacity for each participant. The continuous measure that was used for this study was defined as “overall mood state.” This measure was based on a composite measure derived from ISS scores on two scales: the Well-Being Scale score and Depression Index score (see Appendix V). Following z-score transformations, the Well-Being Scale scores were reverse scored and added to the Depression Index scores (negative correlation between subscales=.71) in order to construct an overall mood state score for each participant (higher scores = higher levels of depressed mood; lower scores = higher levels of manic mood). The overall mood state score at each sampling time
point, along with the measure of working memory capacity at each sampling time point, were the two main measures used in this study.\textsuperscript{16}

Measurement of Working Memory Capacity. Scores on the Automated Osan for PDA served as a measure of the working memory capacity of participants at the time of measurement. Scores were calculated by adding the total number of words that the participant remembered correctly during each measurement period (e.g., a participant’s score for a particular measurement period was “7” if they remembered 7 out of 10 words.)\textsuperscript{17} The number of correct answers to the arithmetic problems was also measured, in order to ensure that participants were not “trading off” between remembering words and solving problems. If participants did not answer a majority of arithmetic problems correctly, their Osan score was not counted for that measurement trial, as was consistent with the literature (see “Results” section for a discussion of missing data)(Conway et al, 2003).\textsuperscript{18}

Data Analyses

The concurrent and time-lagged functional relations between measures of mood and working memory capacity were analyzed via a series of multivariate time-series regression analyses using the Statistical Package for the Social Sciences (SPSS)

\textsuperscript{16} See Appendix W for a description of follow-up exploratory analyses on the classification of mood state into “manic” “mixed” and “depressed” mood states for each participant (to be completed as post-hoc analyses).

\textsuperscript{17} See PDA: Instruments, Measures, and Measurement Procedures section for further information on Automated Osan scores.

\textsuperscript{18} As noted previously, this accounted for only 1-3% of data for participants.
Forecasting Module for each participant. Multiple regression models that involved one predictor variable and one criterion variable were analyzed over time. Due to the time-series methodology used in this manuscript, autocorrelation was also examined as part of the Forecasting Module regression analyses. Autocorrelation occurs in a series of observations, in which the value of one observation in a time series may depend (to a variable degree) on the value of one or more of the preceding observations in the same time-series (Nash et al., 2011). Autocorrelation was analyzed (in terms of the difference from zero) by a Ljung-Box test of residuals for each time series analysis (Ljung & Box, 1978).

Shared variance between overall mood state and working memory capacity was examined for each participant, for a specific time \((t_i)\), as well as the time at lag 1 \((t_{i-1})\). A series of full and restricted regression equations was used. In the first three analyses mentioned below, Ospan score was the criterion variable \((Y_i)\), and overall mood state score was the predictor variable \((X_i)\) for a given time \((t_i)\) and the time at lag 1 \((t_{i-1})\). In the fourth analysis, overall mood state score \((X_i)\) was the dependent variable, and Ospan score \((Y_i)\) was the independent (or predictor) variable for the time at lag 1 \((t_{i-1})\). In each analysis, \(\beta\) indicated the weight of the predictor variable(s), and \(e\) represented error. See figure 1 for a visual diagram of the variables and paths that address the goals of the study:

(a) The degree to which variance in working memory capacity could be accounted for by variance in time-lagged \((t_{i-1})\) measures of mood state was examined. This time-lagged measure represented the degree to which an overall mood state score at the last previous measurement trial predicted an Ospan score at the present measurement trial.

\[
Y_{ti} = \beta X_{ti-1} + e_{ti}
\]
(b) The degree to which variance in working memory capacity could be accounted for by concurrent measures of mood state was examined (see figure 1). This non-time lagged measure represented the degree to which an overall mood state score predicted an Ospan score, at the same measurement trial.

\[ Y_{ti} = \beta X_{ti} + \epsilon_{ti} \]

(c) The degree to which variance in working memory capacity could be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements was examined. This represented the degree to which an overall mood state score predicted an Ospan score, at the same measurement trial, after accounting for the last previous Ospan score. In order to do this, the incremental variance was examined from two models.

1. \[ Y_{ti} = \beta Y_{ti-1} + \epsilon_{ti} \]
2. \[ Y_{ti} = \beta X_{ti} + \beta Y_{ti-1} + \epsilon_{ti} \]

Model (1) indicated the degree to which an Ospan score was predicted by the preceding Ospan score. Model (2) expanded this model by adding the present overall mood state score to the preceding Ospan score, (and was performed only if goal b was proven to be true for each participant). The \( R^2 \)s of these two models was compared; while testing for the significance of the change in \( R^2 (\Delta R^2) \).

(d) The degree to which variance in overall mood state score could be accounted for by previous working memory capacity measurements was examined. This time-lagged (t-1) measure represented the degree to which a previous mood state score on the last previous measurement trial predicted an overall mood state score. This analysis examined an alternative hypothesis; that mood state may be affected by previous
measures of working memory capacity.

\[ X_{ti} = \beta Y_{ti-1} + e_{ti} \]

Figure 1

*Path Diagram of Analyses*

\[ Y=\text{Ospan Score} \]
\[ X=\text{overall mood state score} \]
III. Results

*Working Memory Capacity and Mood State for Each Participant over Time*

Table 2 presents each participant's true scores of the mood state and working memory capacity measures (the Well-Being and Depression Index scales of the ISS, and the Ospan score) over the duration of the study. The ISS subscales in Table 2 do not reflect the “Overall Mood State” z-score measures used for the time series analyses (see the “Methods” section for details on how this variable was created). Rather, both scale scores of the ISS are presented at each time point in order to observe the approximate average mood state experienced by each participant across all time points. Missing data for each participant across the duration of the study, which affected the time-lagged time series analyses (see “Management of Missing Data for Time-Lagged Time Series Analyses” subsection, below), are also presented.
Table 2

Participants’ Internal States Scale (ISS) scores and Ospan Scores over Time:

<table>
<thead>
<tr>
<th>Participant</th>
<th># of Measurement Days</th>
<th># of Measurement Points</th>
<th># Missing Measurement Points*</th>
<th>Mean of True Scores: ISS Well-Being Index Score**</th>
<th>Standard Deviation of True Scores: ISS Well-Being Index Score</th>
<th>Mean of True Scores: ISS Depression Index Score</th>
<th>Standard Deviation of True Scores: Depression Index Score</th>
<th>Mean of True Scores: Ospan Score***</th>
<th>Standard Deviation of True Scores: Ospan Score***</th>
</tr>
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<td>1</td>
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<td>12</td>
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<td>.976</td>
</tr>
</tbody>
</table>

* Data were labeled as “missing” if accuracy criterion on the Ospan was not met or if the participant did not enter data at the required time point.

** The two ISS subscales are not equivalent in value; the maximum for the Wellbeing Scale=300, minimum of 0; maximum for the Depression Index= 200, minimum of 0).

*** “Ospan Score” is derived from number of words correctly remembered on the Automated Ospan, see “Methods” section for details.

Figures 2-15 show z-score transformed measures of the two ISS subscales (relabeled as “Overall Mood State” score across time, and the Ospan Score (relabeled as “Working Memory Score) across time. There are two graphs for each participant to enable viewing the data graphically organized by days as well as across singular time points.
Figure 2.

*Participant 1: Day Graph*
Participant 1: Overall Time Graph

![Participant 1: Overall Time Graph](image-url)
Figure 4

Participant 2: Day Graph
Figure 5

Participant 2: Overall Time Graph

![Graph showing overall time graph for Participant 2 with two lines representing Z score overall mood state and Z score working memory over time.](image-url)
Figure 6

Participant 3: Day Graph
Figure 7

Participant 3: Overall Time Graph
Figure 8

Participant 4: Day Graph
Figure 9

Participant 4: Overall Time Graph
Figure 10

Participant 5: Day Graph
Figure 11

Participant 5: Overall Time Graph
Figure 12

Participant 6: Day Graph
Figure 13

*Participant 6: Overall Time Graph*
Figure 14

Participant 7: Day Graph

[Image of a line graph showing Z-Score Transformations of Overall Mood State and Working Memory for Participant 7 over time.]
Figures 2-15 show the z-score transformed measures of Ospan score (labeled “Working Memory Score”) and ISS Well-Being and Depression subscale scores (transformed into the “Overall Mood State” variable used in the time series analyses) in two different fashions: (1) Across separate days (Day Graphs) and every valid time point used in the study (Overall Time Graphs). They do not include missing data (see “Limitations” section).

In addition, in order to observe potential cycles and/or trends in participants’ data, weekly averages for: (1) ISS Well-Being Scale Score (2) Depression Index Scale Score
(3) Overall Mood State score (4) Ospan score and (5) Z-score transformed Ospan score were compiled. Tables 3-9 show these weekly averages.

Table 3.

**Participant 1: Weekly Averages of Mood State and Working Memory Capacity Scores**

<table>
<thead>
<tr>
<th>Week #</th>
<th>ISS Well-Being Scale Score</th>
<th>ISS Depression Index Score</th>
<th>Overall Mood State Score</th>
<th>Ospan Score</th>
<th>Z-Score Transformed Ospan Score</th>
</tr>
</thead>
<tbody>
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<td>8.30</td>
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</table>

Table 4.

**Participant 2: Weekly Averages of Mood State and Working Memory Capacity Scores**

<table>
<thead>
<tr>
<th>Week #</th>
<th>ISS Well-Being Scale Score</th>
<th>ISS Depression Index Score</th>
<th>Overall Mood State Score</th>
<th>Ospan Score</th>
<th>Z-Score Transformed Ospan Score</th>
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</thead>
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Table 5

**Participant 3: Weekly Averages of Mood State and Working Memory Capacity Scores**

<table>
<thead>
<tr>
<th>Week #</th>
<th>ISS Well-Being Scale Score</th>
<th>ISS Depression Index Score</th>
<th>Overall Mood State Score</th>
<th>Ospan Score</th>
<th>Z-Score Transformed Ospan Score</th>
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<td>173</td>
<td>73</td>
<td>.22</td>
<td>6.46</td>
<td>-.11</td>
</tr>
<tr>
<td>2</td>
<td>165</td>
<td>85</td>
<td>.10</td>
<td>7.18</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>152</td>
<td>106</td>
<td>-.14</td>
<td>6.44</td>
<td>-.13</td>
</tr>
<tr>
<td>4</td>
<td>187</td>
<td>73</td>
<td>-.03</td>
<td>7.50</td>
<td>0.47</td>
</tr>
<tr>
<td>5</td>
<td>159</td>
<td>95</td>
<td>-.02</td>
<td>6.53</td>
<td>-0.08</td>
</tr>
<tr>
<td>6</td>
<td>85</td>
<td>158</td>
<td>-.10</td>
<td>5.53</td>
<td>-0.65</td>
</tr>
</tbody>
</table>

Table 6

**Participant 4: Weekly Averages of Overall Mood State and Working Memory Capacity**

<table>
<thead>
<tr>
<th>Week #</th>
<th>ISS Well-Being Scale Score</th>
<th>ISS Depression Index Score</th>
<th>Overall Mood State Score</th>
<th>Ospan Score</th>
<th>Z-Score Transformed Ospan Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>231</td>
<td>32</td>
<td>-0.75</td>
<td>7.11</td>
<td>0.14</td>
</tr>
<tr>
<td>2</td>
<td>280</td>
<td>4</td>
<td>-0.63</td>
<td>7.24</td>
<td>0.20</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>23</td>
<td>0.02</td>
<td>7</td>
<td>0.06</td>
</tr>
<tr>
<td>4</td>
<td>232</td>
<td>2</td>
<td>0.20</td>
<td>7.06</td>
<td>0.01</td>
</tr>
<tr>
<td>5</td>
<td>225</td>
<td>4</td>
<td>0.23</td>
<td>6.54</td>
<td>-0.22</td>
</tr>
<tr>
<td>6</td>
<td>145</td>
<td>11</td>
<td>1.27</td>
<td>6.08</td>
<td>-0.50</td>
</tr>
</tbody>
</table>
Table 7

*Participant 5: Weekly Averages of Mood State and Working Memory Capacity*

<table>
<thead>
<tr>
<th>Week #</th>
<th>ISS Well-Being Scale Score</th>
<th>ISS Depression Index Score</th>
<th>Overall Mood State Score</th>
<th>Ospan Score</th>
<th>Z-Score Transformed Ospan Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>105</td>
<td>0</td>
<td>-0.22</td>
<td>5.32</td>
<td>-0.40</td>
</tr>
<tr>
<td>2</td>
<td>93</td>
<td>16</td>
<td>-0.54</td>
<td>4.65</td>
<td>-0.72</td>
</tr>
<tr>
<td>3</td>
<td>72</td>
<td>10</td>
<td>0.78</td>
<td>5.37</td>
<td>-0.37</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td>11</td>
<td>0.31</td>
<td>5.79</td>
<td>-0.17</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td>32</td>
<td>-0.93</td>
<td>8.05</td>
<td>0.92</td>
</tr>
<tr>
<td>6</td>
<td>69</td>
<td>26</td>
<td>0.01</td>
<td>7.83</td>
<td>-0.56</td>
</tr>
</tbody>
</table>

Table 8

*Participant 6: Averages of Mood State and Working Memory Capacity Scores*

<table>
<thead>
<tr>
<th>Week #</th>
<th>ISS Well-Being Scale Score</th>
<th>ISS Depression Index Score</th>
<th>Overall Mood State Score</th>
<th>Ospan Score</th>
<th>Z-Score Transformed Ospan Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>130</td>
<td>.45</td>
<td>5.42</td>
<td>-0.29</td>
</tr>
<tr>
<td>2</td>
<td>88</td>
<td>177</td>
<td>-0.61</td>
<td>7.11</td>
<td>.49</td>
</tr>
<tr>
<td>3</td>
<td>105</td>
<td>152</td>
<td>-.26</td>
<td>5.82</td>
<td>-.11</td>
</tr>
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<td>4</td>
<td>78</td>
<td>165</td>
<td>-.07</td>
<td>7.07</td>
<td>.47</td>
</tr>
<tr>
<td>5</td>
<td>53</td>
<td>181</td>
<td>.01</td>
<td>6</td>
<td>-.03</td>
</tr>
<tr>
<td>6</td>
<td>118</td>
<td>106</td>
<td>.77</td>
<td>4.5</td>
<td>-0.73</td>
</tr>
</tbody>
</table>
Table 9

*Participant 7: Averages of Overall Mood State Score and Working Memory Capacity*

<table>
<thead>
<tr>
<th>Week #</th>
<th>ISS Well-Being Scale Score</th>
<th>ISS Depression Index Score</th>
<th>Overall Mood State Score</th>
<th>Ospan Score</th>
<th>Z-Score Transformed Ospan Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>196</td>
<td>78</td>
<td>-.47</td>
<td>2.75</td>
<td>-.23</td>
</tr>
<tr>
<td>2</td>
<td>189</td>
<td>78</td>
<td>-0.36</td>
<td>3.25</td>
<td>.28</td>
</tr>
<tr>
<td>3</td>
<td>129</td>
<td>55</td>
<td>1.06</td>
<td>2.91</td>
<td>-.06</td>
</tr>
</tbody>
</table>

*Participant 7’s final three weeks of data were incomplete and not filled out correctly. She was not able to stay in the study longer (see “Limitations” section)

Means, Standard Deviations, Trends, and Weekly Averages in Measures of Mood State and Working Memory Capacity

Means and Standard Deviations of Internal State Scale Scores and Ospan Scores. As indicated in Table 2, means of the ISS Well-Being Index scale varied from 81 to 223. Standard deviations of the ISS Well-Being Index scale varied from 21 to 65. The scale has a minimum of 0 and a maximum of 300. Means of the Depression Index scale score varied from 13 to 154. Standard deviations of the Depression Index scale score ranged from 18 to 44. The scale has a minimum of 0 and a maximum of 200. Means of Ospan scores from 2.98 to 8.25. Standard deviations of Ospan scores ranged from .976 to 2.14. The scale has a minimum of 0 and a maximum of 10.

Trends in Overall Mood State Score and Working Memory Capacity across the study. The trends in the data appeared to be: high variability, no linear trend, no cyclicity (as illustrated graphically by Figures 2-15 as well as the raw data in Table 2). Figures 2-15 also illustrate differences in the degree to which participants fluctuated across time in
their mood states. Participants also differed in how much they varied across time on their Mood State and Working Memory Capacity scores (as indicated by peaks and valleys in the graphs as well as the means and standard deviations from Table 2). The highest variability for Well-Being Index score was demonstrated by Participant #7 (SD=65), and the lowest variability was demonstrated by Participant #5 (SD=21). The highest variability for Depression Index Scale score was demonstrated by Participant #3 (SD=44), and the lowest by Participant #5 (SD=18). In terms of Ospan score, Participant #6 demonstrated the highest variability (SD=2.14) and Participant #7 demonstrated the lowest (SD=.976).

In terms of trends in these data across weeks, Tables 3-9 show the weekly averages for each participant. Participant #1’s data did not show any clear weekly trends across averages (see Table 3). Participant #2 showed a linear decrease in average Working Memory Capacity scores that did corresponded with a linear-decrease in Well-Being scale score with any average measurements of mood state (see Table 4). Participant #3’s data showed some cyclicity across weeks for average Well-Being and Depression Index scores that did not appear to impact average Working Memory Capacity scores (see Table 5). For Participant #4, there appeared to be a linear decrease in the average Working Memory Capacity scores across the weeks of the study, that correlated with a linear decrease in the average Well-Being scale score (with minor fluctuations, see Table 6). Participant #5 showed the somewhat surprising trend of average Working Memory

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19 It is important to note that the mood state measure used in the time series analyses following was derived from a z-score transformation of these two scales of the ISS (see “Methods” section).
Capacity score increasing with an increasing average Depression Index score and a decreasing average Well-Being Index score towards the end of the study (see Table 7). Participant #6’s data did not appear to show any clear trend in the weekly average scores (see Table 8). Lastly, Participant #7’s data also did not appear to show any clear trends across weekly averages (see Table 9). It should be noted that weekly averages for the dependent variables tended to decrease (Ospan) scores tended to decrease (participants #2, #3, #4, and #6) as opposed to increasing, over time for four out of seven participants, perhaps indicating a lack of motivation for the “Thinking and Feeling” task at the end of the six week period.

Management of Missing Data for Time-Lagged Time Series Analyses

As noted previously in Table 2, the majority of participants had missing data throughout the study. Missing values did not affect the concurrent time series analyses (0-order correlations between WMC and mood). However, for the time-lagged time series analyses, the data was transformed in the following ways: (1) If a whole day was missing (3 data points), the day was excluded from the analyses (2) If one or two data points were missing, then the missing data points were replaced using the method of linear interpolation across data from that day. This method has been well-established for managing missing data in time series analyses and is preferable to running the analyses with a significant portion of missing data (mainly two data points per day over several days) for the majority of participants (Lin, 2006). This affected the data analyses, however, in that the assumed principle of equal time-intervals for time series analyses was not followed and thus inferences drawn from this study may not be generalizable to a larger population (see “Limitations” section).
Time Series Analyses of the 0-order and Time-Lagged Relationships Between Overall Mood State and Working Memory Capacity

Tables 10-16 show the following time series analyses data: the results of the Ljung-Box test\textsuperscript{20}, the mean of the Residual Autocorrelation Function (ACF) at lag 1 for the criterion variables, the regression coefficient $R^2$ of the criterion and predictor variables for each of the four goals of the study, the model parameters of the predictor variables\textsuperscript{21}, and the degree to which the predictor variables were significant in each model (i.e. whether or not the goal was significant) for each participant. It should be noted that if analysis (b) (the degree to which variance in working memory capacity can be accounted for by concurrent measures of mood state) was nonsignificant, then analysis (c) (the degree to which variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements) was also nonsignificant due to the fact that overall mood state did not predict working memory capacity for this participant (and was not run in these

\textsuperscript{20} The Ljung-Box test provides an indication as to whether the ARIMA models created in the time-series analyses are correctly specified. A significance value of less than .05 indicates that there is structure in the observed series that is not accounted for by the model, and thus the fit of the ARIMA models may not be as “good” as the $R^2$ or p value suggests. (Ljung and Box, 1978).

\textsuperscript{21} The SPSS Model Parameters table lists any predictor variables that it finds in the model, along with the predictor variable’s t and p values (SPSS Forecasting Manual, 2007).
Mean Residual ACF at lag 1 only significantly affected the $R^2$ values if the value fell outside of the range of -.2 to .2.

Table 10

*Participant 1 Time Series Analyses*

<table>
<thead>
<tr>
<th>Goal*</th>
<th>Ljung-Box Test p value**</th>
<th>Mean of Residual ACF (Lag 1)</th>
<th>Significant Autocorrelation?</th>
<th>$R^2$</th>
<th>Model Parameters of Predictor Variable***</th>
<th>Significant Predictor Variable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>.940</td>
<td>-.008</td>
<td>No</td>
<td>.001</td>
<td>$t$=$-.372$</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$p$=.711</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>.273</td>
<td>-.128</td>
<td>No</td>
<td>.038</td>
<td>$t$=$-1.05$</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$p$=.181</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>n/a</td>
<td>n/a</td>
<td>No</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>D</td>
<td>0.00</td>
<td>.650</td>
<td>Yes</td>
<td>.044</td>
<td>$t$=$-.511$</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$p$=.610</td>
<td></td>
</tr>
</tbody>
</table>

*the degree to which: (a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements, (d) variance in mood state can be accounted for by previous working memory capacity measurements*

** Degrees of Freedom$^{22}=18$, significance level $=p<.05$

*** significance level $= p<.05$

$^{22}$ The statistical package used in this study, SPSS, sets the Q statistic (DoF) to 18 when analyzing prediction models despite the number of parameters in the model. This does not affect the significance value, however, as would be expected from other statistical tests (SPSS Forecasting Manual, 2007).
Table 11

**Participant 2: Time Series Analyses**

<table>
<thead>
<tr>
<th>Goal*</th>
<th>Ljung-Box Test p value**</th>
<th>Mean of Residual ACF (Lag 1)</th>
<th>Significant Autocorrelation?</th>
<th>R²</th>
<th>Model Parameters of Predictor Variable***</th>
<th>Significant Predictor Variable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.00</td>
<td>.391</td>
<td>Yes</td>
<td>.368</td>
<td>t=1.02</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=.895</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>.604</td>
<td>-.014</td>
<td>No</td>
<td>.408</td>
<td>t=-2.05</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>p=.014</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>.021</td>
<td>-.013</td>
<td>No</td>
<td>.512</td>
<td>t=-2.01</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=.023</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>0.00</td>
<td>.623</td>
<td>Yes</td>
<td>.282</td>
<td>t=-1.63</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=.102</td>
<td></td>
</tr>
</tbody>
</table>

*the degree to which:(a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements,(d) variance in mood state can be accounted for by previous working memory capacity measurements

** Degrees of Freedom=18, significance level= p<.05
*** significance level=p<.05
<table>
<thead>
<tr>
<th>Goal*</th>
<th>Ljung-Box Test p value**</th>
<th>Mean of Residual ACF (Lag 1)</th>
<th>Significant Autocorrelation?</th>
<th>R²</th>
<th>Model Parameters of Predictor Variable***</th>
<th>Significant Predictor Variable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>.085</td>
<td>.158</td>
<td>No</td>
<td>.112</td>
<td>t=-.512</td>
<td>No</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>p=.953</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>.943</td>
<td>.0623</td>
<td>No</td>
<td>.092</td>
<td>t=-.117</td>
<td>No</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>p=.907</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>n/a</td>
<td>n/a</td>
<td>No</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>d</td>
<td>0.00</td>
<td>.471</td>
<td>Yes</td>
<td>.006</td>
<td>t=.118</td>
<td>No</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>p=.906</td>
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</tr>
</tbody>
</table>

*The degree to which: (a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements, (d) variance in mood state can be accounted for by previous working memory capacity measurements

** Degrees of Freedom=18, significance level=p<.05

***Significance level=p<.05
Table 13

Participant 4: Time Series Analyses

<table>
<thead>
<tr>
<th>Goal*</th>
<th>Ljung-Box Test p value**</th>
<th>Mean of Residual ACF (Lag 1)</th>
<th>Significant Autocorrelation</th>
<th>$R^2$</th>
<th>Model Parameters of Predictor Variable***</th>
<th>Significant Predictor Variable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>0.00</td>
<td>.320</td>
<td>Yes</td>
<td>.328</td>
<td>$t = -2.04$</td>
<td>Yes</td>
</tr>
<tr>
<td>b</td>
<td>.510</td>
<td>-0.012</td>
<td>No</td>
<td>.356</td>
<td>$t = -4.86$</td>
<td>Yes</td>
</tr>
<tr>
<td>c</td>
<td>.583</td>
<td>-0.164</td>
<td>No</td>
<td>.336</td>
<td>$t = -3.35$</td>
<td>Yes</td>
</tr>
<tr>
<td>d</td>
<td>0.00</td>
<td>.430</td>
<td>Yes</td>
<td>.139</td>
<td>$t = -1.05$</td>
<td>No</td>
</tr>
</tbody>
</table>

* the degree to which: (a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements, (d) variance in mood state can be accounted for by previous working memory capacity measurements

** Degrees of Freedom=18, significance level=p<.05

*** significance level=p<.05
Table 14

**Participant 5: Time Series Analyses**

<table>
<thead>
<tr>
<th>Goal*</th>
<th>Ljung-Box Test p value**</th>
<th>Mean of Residual ACF (Lag 1)</th>
<th>Significant Autocorrelation?</th>
<th>$R^2$</th>
<th>Model Parameters of Predictor Variable***</th>
<th>Significant Predictor Variable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>.830</td>
<td>.163</td>
<td>No</td>
<td>.35</td>
<td>$t=.40$</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$p=.968$</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>.510</td>
<td>-.051</td>
<td>No</td>
<td>.427</td>
<td>$t=-.428$</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$p=.001$</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>0.12</td>
<td>-.048</td>
<td>No</td>
<td>.51</td>
<td>$t=-.411$</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$p=.024$</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>0.00</td>
<td>.427</td>
<td>Yes</td>
<td>.233</td>
<td>$t=.140$</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$p=.889$</td>
<td></td>
</tr>
</tbody>
</table>

*The degree to which: (a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements, (d) variance in mood state can be accounted for by previous working memory capacity measurements.

** Degrees of Freedom=18, significance level=$p<.05$

***$p<.01$
Table 15

Participant 6: Time Series Analyses

<table>
<thead>
<tr>
<th>Goal</th>
<th>Ljung-Box Test p value*</th>
<th>Mean of Residual ACF (Lag 1)</th>
<th>Significant Autocorrelation?</th>
<th>$R^2$</th>
<th>Model Parameters of Predictor Variable**</th>
<th>Significant Predictor Variable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>.007</td>
<td>.321</td>
<td>Yes</td>
<td>0.202</td>
<td>t=.670</td>
<td>No</td>
</tr>
<tr>
<td>b</td>
<td>.828</td>
<td>.125</td>
<td>No</td>
<td>0.00</td>
<td>t=-.072</td>
<td>No</td>
</tr>
<tr>
<td>c</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>d</td>
<td>0.00</td>
<td>.428</td>
<td>Yes</td>
<td>.213</td>
<td>t=1.04</td>
<td>No</td>
</tr>
</tbody>
</table>

*the degree to which: (a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements, (d) variance in mood state can be accounted for by previous working memory capacity measurements

*Q*= Degrees of Freedom=18, significance level=p<.05
***significance level= p<.05
### Table 16

**Participant 7: Time Series Analyses**

<table>
<thead>
<tr>
<th>Goal*</th>
<th>Ljung-Box Test p value**</th>
<th>Mean of Residual ACF (Lag 1)</th>
<th>Significant Autocorrelation?</th>
<th>R^2</th>
<th>Model Parameters of Predictor Variable***</th>
<th>Significant Predictor Variable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>.690</td>
<td>.141</td>
<td>No</td>
<td>0.001</td>
<td>t=.195</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=.846</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>.407</td>
<td>-.099</td>
<td>No</td>
<td>.004</td>
<td>t=-.410</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=.864</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>d</td>
<td>0.047</td>
<td>.248</td>
<td>Yes</td>
<td>.118</td>
<td>t=-1.01</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=.303</td>
<td></td>
</tr>
</tbody>
</table>

*the degree to which: (a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements, (d) variance in mood state can be accounted for by previous working memory capacity measurements

**Q= Degrees of Freedom=18, significance level=p<.05

***p= <.05

**Mean of Residual Autocorrelation Function (ACF) at Lag 1 Across the Criterion**

**Variables and Results of Ljung-Box Tests**

The means of the residual ACF for the criterion variable at lag 1 for Goal (a) (the degree to which variance in working memory capacity can be accounted for by variance in time-lagged measures of mood state) and the results of the Ljung-Box tests were significant for participants #2, #4, and #6, but nonsignificant for participants #1, 3, 5, and
7. The means of the residual ACF for the criterion variable at lag 1 and the results of the Ljung-Box test for goal (d)(the degree to which variance in mood state can be accounted for by previous working memory capacity measurements) were significant for all participants. The means of the residual ACF at lag 1 and the results of the Ljung-Box tests for Goals (b)(the degree to which variance in working memory capacity can be accounted for by concurrent measures of mood state) and (c)(the degree to which variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements) were nonsignificant for all participants. (see Tables 10-16)

Significant Relationships between Measures of Working Memory Capacity and Mood State

In summary, data presented in Tables 10-16 indicate: (a) The degree to which variance in working memory capacity can be accounted for by time-lagged (t-1) measures of mood state (Goal a) was significant for participant #4, (b) The degree to which variance in working memory capacity can be accounted for by concurrent measures of mood state (goal b) was significant for participants #2, #4, and #5 but nonsignificant for participants #1, #3, #6, and #7, (c) the degree to which variance in working memory capacity can be accounted for by concurrent measures of mood state above and beyond that of previous working memory capacity measurements (Goal c) was significant for participants #2, #4, and #5 but nonsignificant for participants #1, #3, #6, and #7 and (d) the degree to which variance in time-lagged (t-1) measures of working memory capacity

---

23 This was to be expected, since these were the concurrent (non-time lagged at t-1) analyses.
can be accounted for by measures of mood state was nonsignificant for all participants (see Table 17).

Table 17  

*Significant Goals According to Participant*

<table>
<thead>
<tr>
<th>Goal*</th>
<th>Significant for Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>b</td>
<td>2, 4, 5</td>
</tr>
<tr>
<td>c</td>
<td>2, 4, 5</td>
</tr>
<tr>
<td>d</td>
<td>None</td>
</tr>
</tbody>
</table>

*the degree to which: (a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measurements, (d) variance in mood state can be accounted for by previous working memory capacity measurements*
IV. Discussion, Limitations, and Future Directions

Discussion

The goals of this study were to use ecological momentary assessment (EMA) of mood state and working memory capacity in college students with frequent mood fluctuations, using a within-subject time-series methodology, in order to assess the degree to which: (a) variance in working memory capacity can be accounted for by variance in time-lagged (t-1) measures of mood state, (b) variance in working memory capacity can be accounted for by concurrent measures of mood state, (c) variance in working memory capacity can be accounted for by current measures of mood state above and beyond that of previous working memory capacity measures, and (d) variance in mood state can be accounted for by previous working memory capacity measures with a time-lag of t-1.

The findings from this study indicated: (a) a significant relationship between measures of working memory capacity and time-lagged (t-1) measures of mood state for one out of seven participants,24 (b) significant relationships between concurrent measures of working memory capacity and mood state for three out of seven participants, (c) the significant relationships between the concurrent measures of working memory capacity and mood state were above and beyond the relationships between concurrent and time-...

24 It should be noted that a large positive residual autocorrelation at lag 1 (.320) might have affected the fit of this ARIMA model for Participant #4, although the relationship was still significant. If an ARIMA model fails the Ljung-Box test, the model is technically still valid, but the fit of this model may not be as "good" as the R² or p value suggests. (Ljung & Box, 1978).
lagged measures of working memory capacity for the aforementioned three out of seven participants, and (d) no significant relationships between measures of mood state and time-lagged (t-1) measures of working memory capacity.

One major finding of the study (goal b) was that measures of mood state and working memory capacity were significantly related for three of the participants when measured within a time-series design. The direction of these effects differed across participants. For participants #2 and #4, aggregate measures of mood state (i.e. higher mood scores indicated “elevated” or less depressed mood state) were directly and significantly associated with measures of working memory capacity (higher mood state scores were associated with higher working memory capacity). Participant #5 showed an inverse relationship between measures of mood state and working memory capacity. The variance in the relationships between working memory capacity and mood remained significant for all three participants when controlling for time-lagged (t-1) working memory capacity. This is the first study to document a significant time-lagged association between mood state and working memory capacity, indicating that, at least for some subjects, mood state is associated with working memory capacity at a later time. A time-lagged relationship between mood and working memory capacity addresses one component, precedence, of causal inference (Haynes, O'Brien, Kaholokula, 2011). The positive relationships between working memory capacity and mood state for two participants in this time-series study are consistent with and add to results from other non-time-series studies (e.g. Malhi et al., 2007; Goldberg & Chengappa, 2010; Meusel et al., 2013).

25 Demonstrated by the time series analyses in goal (c)
The results for participant #5 (goal b), indicating an inverse relationship between measures of working memory capacity sampled concurrently and mood state at t-1, are not congruent with findings from past research (Martinez-Aran, 2004; Malhi et al, 2007). The significant differences between the findings in this study and findings in past studies in the area of mood and working memory capacity strengthen the assets and implications of using idiographic time-series analyses in the scientific investigation of functional relationships between mood and working memory capacity. Nomothetic investigative strategies could mask some of these idiographic findings.

One inference for the contemporaneous association between mood state and working memory capacity found for some participants in this study is that there may be an “optimally elevated” mood state for which working memory capacity increases above baseline, for some college students. When this elevated mood state decreases, working memory capacity might decrease as well, for these particular college students. This inference is supported by findings from several associations found in previous research on Bipolar Disorder and mood/affect states. In the studies which examined mood state and working memory capacity in persons with Bipolar Disorder, working memory capacity deficits observed in a subject experiencing a depressed or manic mood state returned to “normal” (i.e. the same as a healthy control subject) when the same subject was experiencing a euthymic mood state (see Olley et al., 2005, for a review; Malhi et al., 2007). In addition, the majority of the studies that examined mood state fluctuations across “normal” samples also reported linear relationships between positive affect and cognitive functioning (Ashby et al., 1996; Goldberg & Chengappa, 2010). Lastly, many studies have shown a significant association between depressed mood state and deficits in
working memory capacity, and this remains the strongest association in the mood state and working memory literature to date (see Mitchell & Phillips, 2007, for a review).

In addition, a potential explanation for the associations between concurrent measures of mood state and working memory capacity involves the possible effects of a third factor upon both measures of both mood state and working memory capacity. Variables such as sleep, recent use of caffeine, medication, relationship stressors, or other life stressors have been shown in previous studies to have a significant effect on working memory capacity (Konen et al., 2014; Green & Mc Cormick, 2014)(see “Future Directions” section, below). Due to the possible effects of a third variable, the possible causality of the relationships between mood state and working memory capacity cannot be considered wholly conclusive at this time. The likelihood of a third variable effect is reduced when time-lagged associations are found because such associations can occur only if the time-lagged effect of the third variable differed for the two associated variables. The finding of a significant time-lagged association for only one of the participants does not diminish the likelihood of a third variable effect for some participants.

Finally, another finding of this study indicated that there were no significant relationships between time-lagged measures of working memory capacity (t-1) and mood state (goal d), when measured in a time series design. In addition, significant residual autocorrelations at lag 1 in these ARIMA analyses were observed for all seven participants. These may indicate, in tandem with the non-significant p values for all seven participants, a “poorness-of-fit” for the time series regression models involving past measures of working memory capacity as possible predictors for current mood state (Ljung & Box, 1978). These findings are consistent with other studies in that no studies
to date have found an association between measurements of working memory capacity and mood state, in non-time series designs (Martinez-Aran, 2004; Malhi et al., 2007; Kornsers et al., 2013). Together, these findings are inconsistent with the inference that mood state and working memory capacity have a bidirectional causal relationship.

Overall, the findings of this study indicate that there can be significant, unidirectional relationships between mood state and working memory capacity in some college students with frequent mood fluctuations. These relationships can be temporary and often do not persist across time. In particular, brief decreases in elevated mood state may be predictive of brief decreases in working memory capacity. Thus, for some college students it may be helpful to maintain their levels of “good feelings” before a test (perhaps through programmed self-affirmations on an iPad, brief cognitive therapy, etc.). Lastly, the relationship between working memory capacity and mood state may be accounted for by the common effects of a third variable such as sleep deprivation, caffeine use, medication use, and/or life stressors. It should be noted that this was an exploratory study that sets the precedent for further studies examining working memory capacity and mood.

The ultimate findings of this study indicate that the association between working memory capacity and mood state appears to be unidirectional, which is consistent with previous research. Current depressed mood state is associated with the largest deficits in working memory capacity, which is also consistent with prior studies. This study was unique in that it examined effects over time, and associations between working memory capacity and mood state appear to be time-limited and do not persist over time for the majority of individuals.
Limitations

There were several aspects of the study that limited the generalizability of scientific inferences from the results. These limitations are: measures used, sample composition and time-sampling strategy.

In terms of measures used, the ISS’s Well-Being scale scores and Depression Index scores did not perfectly predict depressed mood and elevated mood in both clinical and non-clinical samples (Bauer, 1991). Thus, the “Overall Mood State” variable created for this study may not accurately reflect the “true” mood state of participants. In addition, the measure created by programming a PDA with the automated Ospan and the ISS had not been validated in previous studies, so its criterion and convergent validity was not established at the time of the study.

In terms of sample composition, there were several notable limitations. The first is that, with a sample size of seven, the within-participant associations found between mood and working memory capacity are not necessarily generalizable to a larger population. For example, participant #5’s inverse relationship between mood state and working memory capacity may have been due to other factors, such as the potential “third factor” mentioned above. Another limitation involves the lack of between-group comparisons in time-series associations between variables (this was not statistically possible with a sample size of seven). For example, only one of the students participating in the study had been formally diagnosed with Bipolar Disorder.26 Thus, the finding that a majority of participants’ (four out of seven) time series analyses did not demonstrate a relationship between mood state and working memory capacity could also have been due to the fact  

26 Participant #4
that the severity of mood state symptoms experienced by the participants in this study was not as significant as it has been shown to be in persons with Bipolar Disorder (Proudfoot et al., 2014). A between-group comparison study with controls, persons with significant mood fluctuations, and persons with Bipolar Disorder could further examine potential differences in mood state and working memory capacity (see “Future Directions” section).

Finally, in terms of time-sampling strategy, an important limitation was that participants’ data were necessarily sampled at unequal time intervals. The time intervals were randomly dispersed throughout the day for all participants (in four-six hour increments), due to their daily schedules. This is somewhat inconsistent with other time series studies, and the presumed conditions for time-series analysis, of mood states, where the times for sampling were the same every day (Almagor & Erlich, 1990; Proudfoot et al., 2014). Sampling at unequal time intervals could also partially account for the differences between the participants who showed associations between mood state and working memory capacity and those who did not.27 These differences between participants could be due to issues with ARIMA analyses that are assumed to be equal time intervals, both concurrent and time-lagged (t-1) (Amerise & Tarsitano, 2009; Velicer et al., 2003).28

Overall, the generalizability of findings to a larger population are limited in this study, due to the issues mentioned above. In addition, the findings for a time-lagged

---

27 However, these two groups were not compared during this study.

28 “Across-night” and “across-day” time series analyses in post-hoc did not reveal significant differences in the goals of the study.
correlation between mood state and working memory capacity were only found for one of six participants (goal a), which also limits the scientific inferences mentioned previously.

**Future Directions**

This study provides the impetus for research in several areas. First, it should be noted that this was the first time-series study on the relationships between mood and working memory capacity. Additional studies are needed to examine the utility of ecological momentary assessment in studies of mood state and working memory capacity. Mood state and working memory capacity are often sampled concurrently in a laboratory, and not with short time-delays over the course of several weeks in naturalistic settings (see Goldberg & Chengappa, 2009, for a review). However, this study sets a precedent for using time-series analyses in mood state and working memory capacity research.

Research studies with a large enough sample size to allow for between-groups comparisons of within-subject associations (as a “Phase II” of a research design consisting firstly of time series analyses) would facilitate greater generalizability of results. For example, Martinez-Aran (2004) looked at groups experiencing hypomanic mood state, depressed mood states, and euthymic mood states when examining cognitive functioning. Examining different groups of college students experiencing different types of mood fluctuations could assist in making the inferences about the relationship between mood states and working memory capacity more applicable to the college student population. As another example, controlling for a Bipolar Disorder diagnosis (in “Phase II”) could also add to the research on mood state and working memory capacity. In these future studies, comparisons could be made between persons with Bipolar Disorder,
persons with frequent mood fluctuations, and controls in terms of mood state and working memory capacity measures in time-lagged (t-1) analyses that would add to the literature examining these differences in non-time series analyses (Martinez-Aran, 2004; Malhi et al., 2007; Goldberg & Chengappa, 2010; Kornsies et al., 2013).

In addition, future studies could examine the possible effect of a third variable on both mood state and working memory capacity. These include but are not limited to: sleep, caffeine, medication use, relationship issues, and/or life stressors. Other studies have shown significant associations between these variables and working memory capacity, independent of mood state (Konen et al., 2014; Klassen et al., 2014; Naismith et al., 2012; Green & Mcormick, 2013).

Finally, future studies could examine how working memory capacity actually translates to test performance in college students. Replication studies could potentially add in a “class exam scores” or “student grades” variable; to examine the degree to which changes in working memory capacity actually affects college students’ performance. Reed and Goetz (2010) incorporated DSM-IV GAF scores as a measure of functioning, but no studies have yet used grades or “real-life” test performance as a factor in the research. Using these factors in future studies would help researchers to see the degree to which mood state and working memory capacity are actually affecting students’ performance in university settings.

Future designs could include replication studies (as outlined above) as well as novel designs that could include the following: use of Iphones as opposed to Palm Pilots for ecological momentary assessment, different mood and memory tasks, and/or different types of participants (i.e. clinical populations as opposed to college students). These
designs could potentially improve upon the lack of generalizability mentioned in previous sections, and add to the literature in working memory capacity and mood state.
V. References


http://dx.doi.org/10.1016/j.jad.2012.08.045.


http://dx.doi.org/10.1016/j.psychresns.2013.06.007.


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## VI. Appendices

### Appendix A: Table of Studies Examining Working Memory Capacity and Mood State

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Title</th>
<th>Method</th>
<th>Subjects</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basso, Lowery &amp; Ghormley et al</td>
<td>2008</td>
<td>Neuropsychological Impairment and psychosis in mania</td>
<td>Archived data collected on psychiatric inpatients. Given neuropsych battery (Trails A and B and Grooved Pegboard) upon admission</td>
<td>40 inpatients</td>
<td>Manic pts. performed worse than controls on measures of working memory (Trails A and B and Grooved Pegboard). Sig differences for Trails A and B: F=6.80, p=.02, n^2=19. Grooved Pegboard, F=8.5, p=.001, n^2=.17</td>
</tr>
<tr>
<td>Mcgrath, Scheldt, Welham &amp; Clair</td>
<td>1997</td>
<td>Performance on tests sensitive to impaired executive ability in schizophrenia, mania and well controls: acute and subacute phases of psychoses</td>
<td>Inpatients and controls tested on NP battery twice in an eight week period (WCST, Stroop, Trails A and B)</td>
<td>58 inpatients, 20 controls</td>
<td>Differences in Stroop, WCST, and Trails A and B at Time 1 were controls&gt;mania&gt;schiz. At Time 2 (subacute) BP pts improved (F=31.54 group diffs for Stroop, 11.29 for Trails A and B).</td>
</tr>
<tr>
<td>Townsend, Bookheimer, Folland-Ross, Sugar &amp; Altshuler</td>
<td>2008</td>
<td>FMRI in prefrontal cortex during a working memory task in manic euthymic and depressed bipolar subjects</td>
<td>Outpatients recruited for study, given an n-back task and had fMRI performed at same time</td>
<td>42 bipolar subjects, 14 controls</td>
<td>No sig differences between groups in n-back task. However, BP subjects with mania did not activate front and right parietal regions involved in WM.</td>
</tr>
<tr>
<td>Adida, Clark, Pomietto et al.</td>
<td>2008</td>
<td>Lack of insight may predict impaired decision making in manic patients</td>
<td>Psychiatric inpatients and controls underwent a decision making task (Iowa Gambling Task).</td>
<td>45 bipolar subjects, 45 controls</td>
<td>22 manic pts with lack of insight made more disadvantageous choices on IGT (t=-3.25, alpha=-.53) than px with insight. All manic pts did significantly worse than controls on IGT (F=21.7, P&lt;.001)</td>
</tr>
<tr>
<td>Malhi, Ivanovski, Hadzi-Pavlović, Mitchell, Vieta et al.</td>
<td>2007</td>
<td>Neuropsychological deficits in bipolar depression, hypomania and euthymia</td>
<td>Outpatients: bipolar depression, hypomania or euthymia. Neuropsych battery (Trails A and B, Stroop, RAVLT, WCST)</td>
<td>25 Bipolar Subjects, 25 controls</td>
<td>Hypomanic pts impaired on recognition (t=3.58, p=.004) and recall (t=4.84, p=.004) of words on RAVLT Key limitation: using same pts again.</td>
</tr>
<tr>
<td>Developers</td>
<td>Year</td>
<td>Measure</td>
<td>Reliability</td>
<td>Validity</td>
<td>Time Required</td>
</tr>
<tr>
<td>------------</td>
<td>------</td>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Broadway, J. &amp; Engle, R.</td>
<td>2010</td>
<td>Running Memory Span Task</td>
<td>So far, no studies on reliability of running span task to WMC.</td>
<td>Broadway and Engle (2010) found it to be a robust measure of WMC.</td>
<td>5-10 minutes</td>
</tr>
<tr>
<td>Moore, M. &amp; Ross, B.</td>
<td>1963</td>
<td>N Back Task</td>
<td>2 back task correlated modestly with 1 back task ($n=38$).</td>
<td>2 back task correlates with WAIS-IV digit span somewhat weakly ($r=0.27$) (Dobbs and Rule, 1989).</td>
<td>5-10 minutes</td>
</tr>
</tbody>
</table>
Appendix C: PDA Demonstration Outline

I. Introduction

a. Principle Investigator (PI) introduces herself to the treatment provider.

b. PI explains that the study is called the “Thinking and Feeling Study”

c. PI explains that the purpose of the study is to examine possible correlations between mood state and working memory capacity, gives brief definition of both terms.

d. PI explains that study is looking for students who experience frequent mood swings, and that their “rapid cycling” students would be ideal, especially if they cycle within a day, but this is not necessary for study

f. PI notes benefits to students including: Starbucks card, $150 cash incentive, and benefits to other students who may be having academic problems due to mood swings

g. PI mentions that the study will be done on a PDA, and students will only have to come into a lab once a week for ½ hour to sync data, however students will have three measurement trials a day for a few weeks (somewhat work intensive).

h. PI answers any questions that treatment provider has about the study.

II. PDA: “Thinking and Feeling (TF) Program”: Demonstration

a. PI turns on the PDA and opens the start up menu, programs an alarm for the TF program within the two minutes.

b. PI responds to the alarm and opens up “TF program”

c. PI enters the “999” subject number (default for PI) and runs through the “TF program.”
d. PI solves ten operations and enters in ten words.

e. If desired, PI will enable the treatment provider to run through the program.

PI programs another alarm with two minutes, and hands PDA to treatment provider. Treatment provider runs through “TF program.”

f. PI answers any questions that the treatment provider has about the study.
Appendix D: Further Treatment Provider Information

The following will be explained verbally to providers by the principle investigator: “The Thinking and Feeling study is looking for students who experience frequent mood changes. These mood changes should not be synonymous with long shifts in mood, such as students who stay in a mood state for over two weeks. Rather, we are looking for students who experience changes in mood over a few days, or within a day. Our study has been provisionally approved by the IRB in Feb of 2012, and was also verbally approved by Dr. Russ Henrie. All subjects will have data de-identified so that there is no risk of confidentiality breach.

The assessment process for students will include: the Young Mania Rating Scale, the Substance Module of the SCID-CV, the Beck Depression Inventory, and the Mood Disorders Module of the SCID-CV. No diagnoses will be made in this study, although we are using the SCID-CV. Rather, we are looking for students who meet our inclusion criteria for frequent changes in mood; and do not meet the exclusion criteria, which involves current use of cocaine, ecstasy, or methamphetamine, or current suicidality. Should suicidality become an issue in assessment, you will be notified via email immediately. A detailed list of inclusion and exclusion criteria can be found on our Referral Form.

If you are interested in referring students to our study, please schedule a time to speak with them about the study. Please fill out the Referral Form with a student present,
and ask them to sign the Permission Form. This will allow us to contact them. I will now
answer any questions you may have. Thank you for your time.”
Appendix E: Referral Form For Providers

____________________ (Your Name)
____________________ (Contact Email)

This study examines how students think and feel over time. This study has been approved by the IRB. It has been discussed and provisionally approved by Dr. Russ Henrie at the UH Manoa Center for Counseling and Student Development. The study will take approximately eight weeks. The benefits to the student include $150 stipend for the duration of the study. Other benefits include participating in a study that will further knowledge about memory and mood. With the student’s permission, we can provide a results summary of the results to the student’s counselor. We will also include a meeting with the counselor to review the results of the study.

The study is being conducted by Rachael Polokoff, M.S. under the supervision of Dr. Stephen Haynes, Ph.D. Our lab can be contacted at 808-554-0649.

Inclusion in our study depends on the following criteria. Please check the criteria boxes that apply to the student.

Inclusion Criteria:

[ ] Student experiences frequent mood state changes (e.g., every day or every few days, from “depressed” to “elated,” etc.)

Exclusion Criteria:
We are seeking persons with frequent mood state changes that are not associated with drug use and who are not at immediate risk for suicidal behaviors.

PLEASE PROCEED TO PERMISSION FORM IF STUDENT MEETS CRITERIA.

Please mail the completed forms in the provided envelope to:
Rachael Polokoff, M.S.
Dept of Psychology
Sakamaki C-400,
University of Hawaii, Manoa 96826

After we receive these forms, the student will be contacted for an in-depth interview by an advanced doctoral level therapist. You will be notified via email about the student’s acceptance or exclusion from this study.
Appendix F: Permission Form: For Potential Participants

Thinking and Feeling Study: Permission Form

This study examines how students think and feel over time. The study will run for eight weeks. Potential participants will be compensated $150 at the completion of the study. I give my permission for the principle investigator of this study to contact me about this study. I understand that I will be asked further questions about my mood states, and that I do not have to respond to any questions that I do not wish to answer.

______________________________
Name (Printed)

______________________________
Name (Signed)

______________________________
Date

______________________________
Contact Phone Number

______________________________
Best times to call
Appendix G: Initial Phone Contact With Students

“Hello, my name is Rachael Polokoff. I work for the Psychology Dept at University of Hawaii, Manoa. I am contacting you about your interest in the Thinking and Feeling study. Your counselor, ______, sent us a permission form to contact you. Is that OK?”

(If answer is no)

“No problem, thank you so much for your time.” (Terminate Call)

(If answer is yes)

“OK, let me tell you a bit more about this study. We are interested in how students think and feel over time. It involves eight weeks of simple thinking and feeling tasks. You will not have to come into university for these tasks, as they all will be done via a hand-held device. Participants that are selected for the study will be compensated monetarily at the end of the study. Our study also includes an interview to assess if you meet the criteria for selection into our study. If you are selected for an interview, you will receive a $10 Starbucks gift card. Does this sound like it may interest you?”

(If answer is no)

“No problem, thanks for your time.” (Terminate call after wishing student a pleasant day.)

(If answer is yes)

“Ok, I’d like to ask you a brief question over the phone. All your answers will be completely confidential, and this ensured through the dept of Psychology. 1. Do you often experience frequent changes in mood throughout the day, or across several days?

(If answer is no)
“I’m sorry, but you will not be eligible for our study. Thank you very much for your time.”

(If answer is yes)

“Great, at this point it looks like you will be eligible for the next step of our study, which involves formal consent as well as formal assessment of your mood states. Can we schedule a time for you to come into my office for a formal interview? The entire process will take about 2 hours. You will be compensated with a $10 Starbucks gift card, whether or not you formally enroll in the study. Do you have any further questions?” (Answer any questions student may have, schedule time with the student and terminate call, after wishing them a pleasant day).
Appendix H: Consent to Assessment Form

Aloha,

The Thinking and Feeling study has an assessment process to see if you are qualified to participate. Each person that participates in assessment will receive a $10 Starbucks card, whether or not they are accepted into the study. The assessment questions contain personal information about substance use, mood states, and daily behaviors. All information will be de-identified and will not contain your name. All data will be kept in a locked cabinet in Sakamaki- D-412. The assessment battery will take approximately 2 hours of your time.

If you consent to proceed, please sign below. A formal consent to participate form will also be reviewed with you, if you are selected.

Mahalo,

Rachael Polokoff, M.S.

Your Name_____________________

Date_______________________
Appendix I: Study Explanation (Outline)

I. PDA Operation
   (a) The PI will explain how to turn on and charge the PDA.
   (b) The PI will demonstrate the alarm going off, and how to open the “TF program”, using the default PI ID # of 999.
   (c) The PI will run through the “TF program” while the student watches.
   (d) The PI will demonstrate how to charge the battery of the PDA with the charge cord.

II. Time Sampling. PI will explain the following:
   (a) Students will need to enter data 3 X daily.
   (b) There will be a 15 window between the alarm and the time that the program will not allow them to enter data.
   (c) The program must be run through in its entirety; i.e. they cannot do “half” of the program.
   (d) They will not know when the alarms will go off, but they can block off time every week where it cannot go off (i.e. class, sleep time).

III. Weekly Meetings. PI will explain the following:
   (a) We will meet weekly to go over scheduling.
   (b) Data will be “Hot Synced” according to student’s unique ID number.
   (c) Weekly meetings will be brief (< ½ hour).

IV. Study Duration. PI will explain the following:
   (a) Study will be six-eight weeks.
(b) Students can withdraw but will only be paid up to the point that they leave the study.

V. Compensation

(a) Students will be paid at the end of study, $150, unless they withdraw.
Appendix J: Informed Consent Form

Consent to Participate in Research Project:
An Ecological Momentary Assessment Study of Thinking and Feeling in College Students

My name is Rachael Polokoff, M.S. I am a graduate student at the University of Hawaii’s at Manoa (UH), in the Department of Psychology. The purpose of my current research project is to evaluate the relationship between thinking and feeling in university students.

**Project Description - Activities and Time Commitment:** If you decide to participate, I will interview you once in person, which will take about 2 hours today. The interview will consist of an assessment of how you have recently been feeling. If selected for the study, I will give you a Personal Digital Assistant (PDA). The PDA will sound with an alarm three times a day, which I will program around your individual class and work schedule. The alarm will signal a short feelings scale for you to fill out. This will take approximately 2 minutes. Next, a brief thinking test will load onto the PDA, which will take approximately 3 minutes. Thus, the overall time commitment per day will be approximately 18 minutes. The study will be conducted over 8 weeks. In addition, once a week I will ask you to come to my office in Sakamaki D-412 for 15 minutes in order to “hot-sync” the PDA data to our database. All data will be backed up regularly.

**Benefits and Risks:** If you decide to participate I will financially compensate you with $150 dollars at the end of the study. If you decide to withdraw at any point you will still be financially compensated. The amount will depend on the number of weeks that you remain in the study. In addition, after the initial assessment interview today I will give you a $10 Starbucks gift card, regardless of whether or not your are selected for the study.

The results of this project may benefit other students. I believe there is little risk to you in participating in this project. If, however, you are uncomfortable or stressed by answering any of the initial interview questions, we will skip the question, or take a break, or stop the interview, or withdraw from the project altogether. In addition, if you become overly distressed at any point during the 8-week process your treating psychologist can be notified, with your permission, to discuss treatment modifications. Participation in this study is voluntary and you may withdraw at any point without any loss to the benefits described above.

**Confidentiality and Privacy:** During this research project, I will keep all data from the interviews in a secure location. Only I and my research assistant will have access to the data, although legally authorized agencies, including the University of Hawaii’s Committee on Human Studies, have the right to review research records. In addition, only my research assistant and I will have access to your mood symptoms interview, your daily mood symptoms, and your daily working memory test results.

The data from the PDAs will not have any of your identifying information and will be analyzed via computer. No data analyzed will contain your name or other identifying
information. The PDA will have a programmable “lock” so that only you can use it. Your anonymity is protected in this fashion. In addition, in the analysis you will have a subject number, and will not be identified by name.

When I report the results of my research project, and in my typed transcripts, no identifying information will ever be used.

**Voluntary Participation:** Participation in this research project is voluntary. You can choose freely to participate or not to participate.

**Questions:** If you have any questions about this project, please contact me at via phone (808) 554-0649 or e-mail (polokoff@hawaii.edu). If you have any questions about your rights as a research participant, in this project, you can contact the University of Hawai‘i, Committee on Human Studies (CHS), by phone at (808) 956-5007 or by e-mail at uhirb@hawaii.edu.

Please keep the prior portion of this consent form for your records.

If you agree to participate in this project, please sign the following signature portion of this consent form and return it to ***.

Tear or cut here

**Signature(s) for Consent:**

I agree to participate in the research project entitled “An Ecological Momentary Assessment Study of Thinking and Feeling in College Students” I understand that I can change my mind about participating in this project, at any time, by notifying the researcher.

Your Name (Print): _____________________________________________

Your Signature: _____________________________________________

Date: _________________________________________________________

Principle Investigator Signature: _________________________________
Appendix K: PDA Training Guide

(1) How to charge the PDA: Plug the PDA charger cord (included) into the small, square-shaped hole at the bottom of the PDA. Plug into wall socket. The PDA’s alarms will still go off even if the PDA is in “hibernate” mode, so do not worry about it being turned on all day. The PDA should be charged overnight for at least four hours per night.

(2) How to turn on the PDA: Press the green button at the top of the PDA.

(3) How to open the “TF (Thinking and Feeling) program” once the alarm sounds:

   press the “house” button the far left corner of the PDA. This will bring you to the main menu. Scroll down with the stylus until you see the “TF program”. Read the instructions and click “Begin.” Remember, you will have 15 minutes in between the alarm and beginning the program before it shuts off.

(4) Enter your ID code with the stylus to begin the study.

(5) Read the “Feeling Task” instructions and hit “Begin.” with the stylus

(6) Answer all questions, using the stylus and the “drop-down” menu, at your own pace.

(7) Read the “Thinking Task” instructions and hit “Begin,” with the stylus

(8) Answer each arithmetic problem with “yes or “no” by clicking the button with the stylus. Remember the word that follows. Answer each problem as quickly as possible.

(9) When the screen with 10 blank lines appears, type in all the words that you remember with the stylus. The keyboard will “pop-up” for typing ease. You can answer the words in any order. If the screen goes into hibernate while you are
attempting to remember words, simply press the green button at the top of the PDA and the keyboard will pop back on the screen.

(10) The “finished” screen will appear. Hit “OK” with the stylus. The main menu will flash up. The PDA will go into “hibernate” mode automatically, so you do not need to press the green button to turn it off. However, if you do, your next alarm will still sound when programmed. Do not forget to charge your PDA overnight!

(11) Please email the principle investigator at: polokoff@hawaii.edu if you have further questions, at any time of day. You call 808 554 0649 with queries 9am-5pm, Monday-Friday.
## Weekly Schedule

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Appendix M: Troubleshooting Contact

I. Introduction
   a. P.I. greets the student and asks how last night’s data entry went.

II. Troubleshooting Issues
   b. P.I. discusses all issues with student
   c. Common issues identified in field testing include: hibernating, charging, and getting “sent back” to the menu screen.
   d. P.I. will have a copy of her training guide with her to help.

III. Schedule of Weekly Follow-up Appointment

IV. Termination of Call
Appendix N: Further Prompts About Mood State

Initial Screening Question: “How often do you experience significant changes in mood?”

If student does not know, ask “Do you often feel extremely elevated (happy, elated, excited), or depressed (down, low, blue)” within one day?

If student says yes, continue with assessment battery.

If student says no, ask “Do you often feel extremely elevated or depressed across 2, 3, or 4 days, before your mood changes again?”

If student say yes, continue with assessment battery.

If student says no, or states that their mood states last longer than 4 days, terminate assessment battery.
Appendix O: SCID-CV: Substance Use Module

SCID-CV Scoresheet

DRUG LIST

Sedatives-hypnotics-anxiolytics ("downers")
Quaalude ("ludes"), Seconal ("reds"), Valium, Xanax, Librium, barbiturates, Miltown, Ativan, Dalmane, Halcion, Restoril

Cannabis
marijuana, hashish ("hash"), THC, "pot," "grass," "weed," "reefer"

Stimulants ("uppers")
amphetamine, "speed," crystal meth, dexadrine, Ritalin, diet pills, "ice"

Opioids
heroin, morphine, opium, Methadone, Darvon, codeine, Percodan, Demerol, Dilaudid

Cocaine
snorting, IV, freebase, crack, "speedball"

Hallucinogens ("psychedelics")
LSD ("acid"), mescaline, peyote, psilocybin, STP, mushrooms, Ecstasy, MDMA

PCP (phencyclidine)
"angel dust," Special K (ketamine)

Other
Steroids, "glue," ethyl chloride, paint, inhalants, nitrous oxide ("laughing gas"), amyl or butyl nitrate ("poppers"), nonprescription sleep or diet pills
E. Alcohol and Other Substance Use Disorders

NONALCOHOL SUBSTANCE USE DISORDERS

Have you ever taken any of these to get high, to sleep better, to lose weight, or to change your mood?

SHOW DRUG LIST (LAST PAGE OF SCORESHEET) TO PATIENT AND RECORD INFORMATION ON SCORESHEET

Which one caused you the most problems?

IF DENIES PROBLEMS: Which one did you use the most?

INDICATE ON SCORESHEET DRUG CLASS WITH HEAVIEST USE/MOST PROBLEMS OR “NONE” IF NO HEAVY DRUG USE AND NO DRUG-RELATED PROBLEMS

IF Nonalcoholic Substance Dependence seems likely, skip to E23, page 60.

IF “NONE” recorded for E17, go to Module F, page 65 (Anxiety and Other Disorders).

NONALCOHOL SUBSTANCE ABUSE

Now I’d like to ask you some questions about your use of [DRUG USED THE MOST OR CAUSED THE MOST PROBLEMS]. During that time...

Did you miss work or school because you were high or very hung over? (How often?) (What about doing a bad job at work or failing courses at school because you used [DRUG]?)

IF NO: What about not keeping your house clean or not taking proper care of your children because of using [DRUG]? (How often?)

CRITERIA FOR NONALCOHOL SUBSTANCE ABUSE

A. A maladaptive pattern of substance use leading to clinically significant impairment or distress, as manifested by one (or more) of the following, occurring within a 12-month period:

(I) recurrent substance use resulting in a failure to fulfill major role obligations at work, school, or home (e.g., repeated absences or poor work performance related to substance use; substance-related absences, suspensions, or expulsions from school; neglect of children or household)
SCID-CV Administration Booklet

E. Alcohol and Other Substance Use Disorders

**E19**
Did you ever use [DRUG] in a situation in which it might have been dangerous? (Did you ever drive when you were really too high to drive?)

IF YES: How often? (When?)

**E20**
Did your use of [DRUG] get you into trouble with the law?

IF YES: How often? (When?)

**E21**
IF NOT ALREADY KNOWN: Did your use of [DRUG] cause problems with other people, such as with family members, friends, or people at work? (Did you ever get into physical fights when you were using [DRUG]?) (What about having bad arguments about your drug use?)

IF YES: Did you keep on using [DRUG] anyway?

**E22**

If E22 is "-" (i.e., no abuse items are "+"), either go back to E17, page 58, if the use of any other class of drug may also have been problematic or excessive, or else go to Module F, page 65 (Anxiety and Other Disorders).

If E22 is "+" (i.e., at least one abuse item is "+") AND you have already checked for Dependence (i.e., evaluated E23–E29 on pages 60–61) and found that fewer than 3 were "+", go to E32, page 62, and make a diagnosis of Nonalcohol Substance Abuse.
E. Alcohol and Other Substance Use Disorders

NONALCOHOL SUBSTANCE DEPENDENCE

I would now like to ask you some more questions about [TIME WHEN USING THE MOST DRUGS/TIME WHEN DRUGS CAUSED THE MOST PROBLEMS]. During that time...

E23 Did you often find that when you started using [DRUG] you ended up using much more than you were planning to?

IF NO: What about using it for a much longer period of time than you were planning to?

E24 Did you try to cut down or stop using [DRUG]?

IF YES: Did you ever actually stop using [DRUG] altogether? (How many times did you try to cut down or stop altogether?)

IF NO: Did you want to stop or cut down? (Is this something you kept worrying about?)

E25 Did you spend a lot of time using [DRUG] or doing whatever you had to do to get it? Did it take you a long time to get back to normal?

E26 Did you have times when you would use [DRUG] so often that you started to use [DRUG] instead of working, spending time with your family or friends, or engaging in other important activities, such as sports, gardening, or playing music?

CRITERIA FOR NONALCOHOL SUBSTANCE DEPENDENCE

A maladaptive pattern of substance use, leading to clinically significant impairment or distress, as manifested by three (or more) of the following, occurring at any time in the same 12-month period:

E23 (3) the substance is often taken in larger amounts OR over a longer period than was intended

E24 (4) there is a persistent desire OR unsuccessful efforts to cut down or control substance use

E25 (5) a great deal of time is spent in activities necessary to obtain the substance (e.g., visiting multiple doctors or driving long distances), use the substance, or recover from its effects

E26 (6) important social, occupational, or recreational activities are given up or reduced because of substance use

NOTE: Criteria for Dependence are presented in a different order than in DSM-IV.
E. Alcohol and Other Substance Use Disorders

(7) the substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance (e.g., current cocaine use despite recognition of cocaine-induced depression)

(1) tolerance, as defined by either of the following:

(a) a need for markedly increased amounts of the substance to achieve intoxication or desired effect

(b) markedly diminished effect with continued use of the same amount of the substance

(2) withdrawal, as manifested by either (a) or (b):

(a) the characteristic withdrawal syndrome for the substance (see page 61)

(b) the same (or a closely related) substance is taken to relieve or avoid withdrawal symptoms
E. Alcohol and Other Substance Use Disorders

**E30** IF UNKNOWN: When did [SYMPTOMS RATED “+” ABOVE] occur? (Did they all happen around the same time?)

**E30** AT LEAST THREE DEPENDENCE ITEMS (E23–E29) ARE “+” AND OCCURRED WITHIN THE SAME 12-MONTH PERIOD

If **E30** is “-” (fewer than three dependence items are “+”) AND you previously skipped E18–E21, pages 58–59 (because dependence seemed likely), return to E18, page 58, and check for Nonalcohol Substance Abuse.

If **E30** is “-” (fewer than three dependence items are “+”) AND **E22**, page 59, is “+” (criteria met for Nonalcohol Substance Abuse), go to **E32**, below.

**E31** IF UNKNOWN: Have you had [SYMPTOMS RATED “-” ABOVE] in the past month?

**E31** MAKE A DIAGNOSIS OF SUBSTANCE DEPENDENCE

Go to **Module F**, page 65 (Anxiety and Other Disorders).

**E32** IF UNKNOWN: Have you had [SYMPTOMS OF ABUSE RATED “-”] in the past month?

**E32** MAKE A DIAGNOSIS OF SUBSTANCE ABUSE

Go to **Module F**, page 65 (Anxiety and Other Disorders).
Appendix P: SCID-CV Mood Disorders Module

**SCID-CV Administration Booklet**

**A. Mood Episodes**

A7 . . . how did you feel about yourself? (Worthless? Nearly every day?)
. . . what about feeling guilty about things you had done or not done? (Nearly every day?)

A8 . . . did you have trouble thinking or concentrating? (What kinds of things did it interfere with? Nearly every day?)
IF NO: Was it hard to make decisions about everyday things?

A9 . . . were things so bad that you were thinking a lot about death or that you would be better off dead? What about thinking of hurting yourself?
IF YES: Did you do anything to hurt yourself?

A7 (7) feelings of worthlessness or excessive or inappropriate guilt (which may be delusional) nearly every day (not merely self-reproach or guilt about being sick)

NOTE: CODE “—” IF ONLY LOW SELF-ESTEEM

A8 (8) diminished ability to think or concentrate, or indecisiveness, nearly every day (either by objective account or as observed by others)

A9 (9) recurrent thoughts of death (not just fear of dying), recurrent suicidal ideation without a specific plan, or a suicide attempt or a specific plan for committing suicide

A10 AT LEAST FIVE OF A(1)–A(9) ARE “+” AND AT LEAST ONE OF THESE IS ITEM A(1) OR A(2).

If A10 above is “—” (i.e., fewer than five are “+”), ask the following if unknown:

Have there been any other times when you’ve been depressed and had even more of the symptoms that we’ve just talked about?

If “yes,” go back to A1, page 3, and ask about that episode.
If “no,” go to A16, page B (Manic Episode).
A. Mood Episodes

**A11** IF UNCLEAR: Has [the depression/OWN WORDS] made it hard for you to do your work, take care of things at home, or get along with other people?

C. The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

If A11 above is "-" (i.e., symptoms not clinically significant), ask the following if unknown:

Have there been any other times when you’ve been depressed and it had more of an effect on your life?

If "yes," go back to A1, page 3, and ask about that episode.

If "no," go to A16, page 8 (Manic Episode).

**A12** Just before this began, were you physically ill?

Just before this began, were you taking any medications?

IF YES: Any change in the amount you were taking?

Just before this began, were you drinking or using any street drugs?

**A13** The symptoms are not due to the direct physiological effects of a substance (e.g., a drug of abuse, medication) or a general medical condition.

**A14** Psychological general medical conditions include degenerative neurological illnesses (e.g., Parkinson’s disease), cerebrovascular disease (e.g., stroke), metabolic conditions (e.g., vitamin B12 deficiency), endocrine conditions (e.g., hyper- and hypothyroidism, hyper- and hypoadrenalism), viral or other infections (e.g., hepatitis, mononucleosis, HIV), and certain cancers (e.g., carcinoma of the pancreas).

**A15** Psychological substances include alcohol, amphetamines, cocaine, hallucinogens, inhalants, opioids, phencyclidine, sedatives, hypnotics, anxiolytics. Medications include antihypertensives, oral contraceptives, corticosteroids, anabolic steroids, anticancer agents, analgesics, anticholinergics, cardiac medications.

If A12 above is "-" (i.e., mood is due to substance or general medical condition), ask the following:

Have there been any other times when you’ve been depressed and it was not because of [GENERAL MEDICAL CONDITION/SUBSTANCE USE]?

If "yes," go back to A1, page 3, and ask about that episode.

If "no," go to A16, page 8 (Manic Episode).
IF UNKNOWN: Did this begin soon after someone close to you died?  

E. The symptoms are not better accounted for by Bereavement, i.e., after the loss [death] of a loved one, the symptoms persist for longer than 2 months or are characterized by marked functional impairment, morbid preoccupation with worthlessness, suicidal ideation, psychotic symptoms, or psychomotor retardation.

If A13 above is "—" (i.e., the depressed mood is better accounted for by Bereavement), ask the following:

Have there been any other times when you've been depressed and it was not because of the loss of a loved one?

If "yes," go back to A1, page 3, and ask about that episode.

If "no," go to A16, page 8 (Manic Episode).

IF UNKNOWN: Have you had (SYMPTOMS RATED "+" ABOVE) in the past month?

CRITERIA A, C, D, AND E ARE "+"

(MAKE A DIAGNOSIS OF MAJOR DEPRESSIVE EPISODE)

How many separate times have you been [depressed? OWN WORDS] nearly every day for at least 2 weeks and had several of the symptoms that you just described, such as [SYMPTOMS OF WORST EPISODE]?

Total number of Major Depressive Episodes, including current (CODE 99 if too numerous or indistinct to count)
A. Mood Episodes

MANIC EPISODE

Have you ever had a period of time when you were feeling so good, high, excited, or hyper that other people thought you were not your normal self or you got into trouble? (Did anyone say you were manic? Was that more than just feeling good?)

What was that like?

IF NO: What about a period of time when you were so irritable that you found yourself shouting at people or starting fights or arguments? (Did you find yourself yelling at people you didn’t really know?)

If A16 is “-” (i.e., never any periods of elevated or irritable mood), go to A45, page 17 (Dysthymic Disorder).

A17 How long did that last? (As long as 1 week? Did you have to go into the hospital?)

... lasting at least 1 week (or any duration if hospitalization is necessary)

If A17 is “-” (i.e., duration is less than 1 week), go to A30, page 13 (Hypomanic Episode).

Have you had more than one time such as that? Which time were you the most [high/irritable/OWN WORDS?]

FOR ITEMS A18–A27 ON PAGES 9–11, FOCUS ON THE MOST EXTREME EPISODE

IF UNKNOWN: During this time, when were you the most [OWN WORDS for euphoria or irritability?]
SCID-CV Administration Booklet

During [PERIOD OF WORST MANIC SYMPTOMS]. . .

A18  . . .how did you feel about yourself?
(More self-confident than usual? Any special powers or abilities?)

A19  . . .did you need less sleep than usual?
IF YES: Did you still feel rested?

A20  . . .were you much more talkative than usual?
(Did people have trouble stopping you or understanding you? Did people have trouble getting a word in edgewise?)

A21  . . .were your thoughts racing through your head?

A22  . . .were you so easily distracted by things around you that you had trouble concentrating or staying on one track?

A23  . . .how did you spend your time? (Work, friends, hobbies? Were you so active that your friends or family were concerned about you?)

IF NO INCREASED ACTIVITY: Were you physically restless? (How bad was it?)

A18  . . . inflated self-esteem or grandiosity

A19  . . . decreased need for sleep (e.g., feels rested after only 3 hours of sleep)

A20  . . . more talkative than usual or pressure to keep talking

A21  . . . flight of ideas or subjective experience that thoughts are racing

A22  . . . distractibility (i.e., attention too easily drawn to unimportant or irrelevant external stimuli)

A23  . . . increase in goal-directed activity (socially, at work or school, or sexually) or psychomotor agitation

A. Mood Episodes

B. During the period of mood disturbance, three (or more) of the following symptoms have persisted (four if the mood is only irritable) and have been present to a significant degree:
A. Mood Episodes

A24. . . did you do anything that could have caused trouble for you or your family? (Buying things you didn’t need? Anything sexual that was unusual for you? Reckless driving?)

A24. . . excessive involvement in pleasurable activities that have a high potential for painful consequences (e.g., engaging in unrestrained buying sprees, sexual indiscretions, or foolish business investments)

A25. AT LEAST THREE OF B(1)-B(7) ARE “+” (OR FOUR IF MOOD IS IRRITABLE AND NOT ELEVATED)

A25. If A25 above is “−” (i.e., fewer than three are “+”) ask the following:

- Have there been any other times when you were [high/irritable/OWN WORDS] and had even more of the symptoms that we’ve just talked about?
  - If “yes,” go back to A16, page 8, and ask about that episode.
  - If “no,” go to A45, page 17 (Dysthymic Disorder).

A26. IF NOT KNOWN: At that time, did you have serious problems at home or at work (school) because you were [SYMPTOMS] or did you have to go into a hospital?

A26. The mood disturbance is sufficiently severe to cause marked impairment in occupational functioning or in usual social activities or relationships with others, or to necessitate hospitalization to prevent harm to self or others, or there are psychotic features.

A26. If A26 above is “−” (i.e., not sufficiently severe) ask the following:

- Have there been any other times when you were [high/irritable/OWN WORDS] and you got into trouble with people or were hospitalized?
  - If “yes,” go back to A16, page 8, and ask about that episode.
  - If “no,” go to A39, page 14 (Criterion C for Hypomanic Episode).
SCID-CV Administration Booklet

A27 Just before this began, were you physically ill?

Just before this began, were you taking any medications?

IF YES: Any change in the amount you were taking?

Just before this began, were you drinking or using any street drugs?

If there is any indication that the mania may be secondary (i.e., a direct physiological consequence of a general medical condition or substance), go to page 20 and return here to make a rating of "-" or "+.

E. The symptoms are not due to the direct physiological effects of a substance (e.g., a drug of abuse, a medication) or a general medical condition.

Note: Manic-like episodes that are clearly caused by somatic antidepressant treatment (e.g., medication, electroconvulsive therapy, light therapy) should not count toward a diagnosis of Bipolar I Disorder but are considered Substance-Induced Mood Disorders.

Etiological general medical conditions
include degenerative neurological illnesses (e.g., Huntington’s disease, multiple sclerosis), cerebrovascular disease (e.g., stroke), metabolic conditions (e.g., vitamin B12 deficiency, Wilson's disease), endocrine conditions (e.g., hyperthyroidism), viral or other infections, and certain cancers (e.g., cerebral neoplasms).

Etiological substances include alcohol, amphetamines, cocaine, hallucinogens, inhalants, opioids, phencyclidine, sedatives, hypnotics, and anxiolytics. Medications include psychotropic medications (e.g., antidepressants), corticosteroids, anabolic steroids, isoniazid, antiparkinson medication (e.g., levodopa), and sympathomimetics/decongestants.

If A27 above is "-" (i.e., the mania is due to a substance or general medical condition), ask the following:

Have there been any other times when you were [high/irritable/OWN WORDS] and you were not [physically ill/taking medication/using SUBSTANCE]?

If "yes," go back to A16, page 8, and ask about that episode.

If "no," go to A45, page 17 (Dysthymic Disorder).
A. Mood Episodes

**A28** IF UNKNOWN: Have you had [SYMPTOMS RATED "+" ABOVE] in the past month?

**A29** How many separate times were you [HIGH/OWN WORDS] and had [ACKNOWLEDGED MANIC SYMPTOMS] for at least a week (or were hospitalized)?

**CRITERIA A, C, D, AND E ARE "+"
*(MAKE A DIAGNOSIS OF MANIC EPISODE)*

Total number of Manic Episodes, including current (CODE 99 if too indistinct or numerous to count)

**YOU ARE FINISHED EVALUATING MOOD EPISODES. GO TO MODULE B (PSYCHOTIC AND ASSOCIATED SYMPTOMS). B1 (PAGE 25).**
HYPOMANIC EPISODE

IF UNKNOWN: When you were [high/irritable/OWN WORDS], did it last for at least 4 days?

Have you had more than one time like that? (Which time were you the most [high/irritable/OWN WORDS]?)

FOR ITEMS A31–A37 ON PAGES 13 AND 14, FOCUS ON THE MOST EXTREME EPISODE

If A30 is “—” (i.e., never any periods of elevated or irritable mood lasting at least 4 days), go to A45, page 17 (Dysthymic Disorder).

During [PERIOD OF MOST EXTREME HYPOMANIC SYMPTOMS]...

A31...how did you feel about yourself?
(More self-confident than usual? Any special powers or abilities?)

A32...did you need less sleep than usual?
IF YES: Did you still feel rested?

A33...were you much more talkative than usual? (Did people have trouble stopping you or understanding you? Did people have trouble getting a word in edgewise?)

A34...were your thoughts racing through your head?

A35...were you so easily distracted by things around you that you had trouble concentrating or staying on one track?

A. Mood Episodes

CRITERIA FOR HYPOMANIC EPISODE

A. A distinct period of persistently elevated, expansive, or irritable mood, lasting throughout at least 4 days, that is clearly different from the usual nondepressed mood.

B. During the period of mood disturbance, three (or more) of the following symptoms have persisted (four if the mood is only irritable) and have been present to a significant degree:

1. inflated self-esteem or grandiosity
2. decreased need for sleep (e.g., feels rested after only 3 hours of sleep)
3. more talkative than usual or pressure to keep talking
4. flight of ideas or subjective experience that thoughts are racing
5. distractibility (i.e., attention too easily drawn to unimportant or irrelevant external stimuli)
A. Mood Episodes

**A36**...how did you spend your time? (Work, friends, hobbies? Were you so active that your friends or family were concerned about you?)

**IF NO INCREASED ACTIVITY: Were you physically restless? (How bad was it?)**

**A37**...did you do anything that could have caused trouble for you or your family? (Buying things you didn’t need? Anything sexual that was unusual for you? Reckless driving?)

**A38**

(6) increase in goal-directed activity (either socially, at work or school, or sexually) or psychomotor agitation

(7) excessive involvement in pleasurable activities that have a high potential for painful consequences (e.g., engaging in unrestrained buying sprees, sexual indiscretions, or foolish business investments)

**AT LEAST THREE OF B1-7 ARE “+” (OR FOUR IF MOOD IS IRRITABLE AND NOT ELEVATED)**

If **A38** is “+” (i.e., fewer than three are “+”), ask the following:

Have there been any other times when you were [high/irritable/OWN WORDS] and had even more of the symptoms that we’ve just talked about?

If “yes,” go back to **A30**, page 13, and ask about that episode.

If “no,” go to **A45**, page 17 (Dysthymic Disorder).

If **A39** is **UNKNOWN**: Is this very different from the way you usually are? (How were you different? At work? With friends?)

C. The episode is associated with an unequivocal change in functioning that is uncharacteristic of the person when not symptomatic.

If **A39** is “+” (i.e., characteristically “hypomanic”), ask the following:

Have there been any other times when you were [high/irritable/OWN WORDS] and you were really different from the way you usually are?

If “yes,” go back to **A30**, page 13, and ask about that episode.

If “no,” go to **A45**, page 17 (Dysthymic Disorder).
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A. Mood Episodes

A40  IF UNKNOWN: Did other people notice the change in you? (What did they say?)

D. The disturbance in mood and the change in functioning are observable by others.

If A40 is "-" (i.e., not observable by others), ask the following:

Have there been any other times when you were [high/irritable/OWN WORDS] and other people did notice the change in the way you were acting?

If "yes," go back to A30, page 13, and ask about that episode.
If "no," go to A45, page 17 (Dysthymic Disorder).

A41  IF UNKNOWN: At that time, did you have serious problems at home or at work (school) because you were [SYMPTOMS] or did you have to go into a hospital?

E. The episode is not severe enough to cause marked impairment in social or occupational functioning, or to necessitate hospitalization, and there are no psychotic features.

If A41 is "-" (i.e., severe enough to cause marked impairment, etc.) AND either hospitalization was required or duration was 1 week or longer, go back to A17, page 8, and recode "+" for that item, then continue with the rest of the ratings for Manic Episode. Otherwise, if there was marked impairment in functioning but duration was less than 1 week, skip to A45, page 17, and eventually code "2" for item D12, page 49.

A42  Just before this began, were you physically ill?

Just before this began, were you taking any medications?

IF YES: Any change in the amount you were taking?

Just before this began, were you drinking or using any street drugs?

F. The symptoms are not due to the direct physiological effects of a substance (i.e., a drug of abuse, a medication) or a general medical condition.

Note: Hypomanic-like episodes that are clearly caused by somatic antidepressant treatment (e.g., medication, electroconvulsive therapy, light therapy) should not count toward a diagnosis of Bipolar II Disorder but are considered Substance-Induced Mood Episodes.

Refer to list of possibly etiological general medical conditions and substances included with item A27 (page 11).
If A42 above is "-" (i.e., the hypomania is due to a substance or general medical condition), ask the following:

Have there been any other times when you were [high/irritable/OWN WORDS] and you were not [physically ill/taking medication/using SUBSTANCE]?

If "yes," go back to A30, page 13, and ask about that episode.
If "no," go to A45, page 17 (Dysphoric Disorder).

A43
If unknown, have you had [SYMPTOMS RATED "4" ABOVE] in the past month?

CRITERIA A, B, C, D, E, AND F ARE "4"
(MAKE A DIAGNOSIS OF HYPOMANIC EPISODE)

A44
How many separate times were you [high/irritable/OWN WORDS] and had [ACKNOWLEDGED HYPOMANIC SYMPTOMS] for a period of time?

Total number of Hypomanic Episodes (CODE 99 if too indistinct or numerous to count)

YOU ARE FINISHED EVALUATING MOOD EPISODES. GO TO MODULE B (PSYCHOTIC AND ASSOCIATED SYMPTOMS), B1 (PAGE 25).
DYSTHYMIC DISORDER

NOTE: For presentations in which there is a history of multiple recurrent Major Depressive Episodes, the clinician may wish to skip the evaluation of Dysthymic Disorder (i.e., go to B1, page 25).

A45 For the past couple of years, have you been bothered by depressed mood, most of the day, more days than not?
(more than half the time?)

IF YES: What was that like?

A. Depressed mood for most of the day, for more days than not, as indicated either by subjective account or observation by others, for at least 2 years. Note: In children and adolescents, mood can be irritable and duration must be at least 1 year.

If A45 is "-" (i.e., no chronic depressed mood...), go to B1, page 25 (Psychotic and Associated Symptoms).

During these periods of [OWN WORDS FOR CHRONIC DEPRESSION], do you find that most of the time you...

A46 ...lose your appetite? (What about overeating?)

A47 ...have trouble sleeping or sleep too much?

A48 ...have little energy to do things or feel tired a lot?

A49 ...feel down on yourself? (Feel worthless, or a failure?)

A50 ...have trouble concentrating or making decisions?

A51 ...feel hopeless?

AT LEAST TWO "B" SYMPTOMS ARE "-"

If A52 is "-" (i.e., fewer than two symptoms are "-"), go to B1, page 25 (Psychotic and Associated Symptoms).
A. Mood Episodes

A53 What is the longest time, during this period of long-lasting depression, that you felt OK? (NO DYSTHYMIC SYMPTOMS)

A55 IF UNKNOWN: Did it begin gradually or did it start with a bad period of depression?

A54 How long have you been feeling this way? (When did this begin?)

A56 E. There has never been a Manic Episode, a Mixed Episode, or a Hypomanic Episode, and criteria have never been met for Cyclothymic Disorder.

A53 C. During the 2-year period (1 year for children or adolescents) of the disturbance, the person has never been without the symptoms in criteria A and B for more than 2 months at a time.

A55 If A53 is “—” (i.e., more than 2 months without symptoms), go to B1, page 25 (Psychotic and Associated Symptoms).

A55 If A55 is “—” (i.e., Major Depressive Episode during first 2 years), go to B1, page 25 (Psychotic and Associated Symptoms).

Note: There may have been a previous Major Depressive Episode provided there was a full remission (no significant signs or symptoms for 2 months) before development of the Dysthymic Disorder. In addition, after the initial 2 years (1 year in children or adolescents) of Dysthymic Disorder, there may be superimposed episodes of Major Depressive Disorder, in which case both diagnoses may be given when the criteria are met for a Major Depressive Episode.
A57
This may need to be deferred until after psychotic disorders have been ruled out.

A58
Just before this began, were you physically ill?

Just before this began, were you taking any medications?

If Yes: Any change in the amount you were taking?

Just before this began, were you drinking or using any street drugs?

If there is any indication that the dysthymia may be secondary (i.e., a direct physiological consequence of a general medical condition or substance), go to page 20 and return here to make a rating of "-" or "-".

A59
If A58 is "-" (i.e., due to a chronic general medical condition or chronic substance use), go to B1, page 25 (Psychotic and Associated Symptoms).

A59
If Unclear: How much do symptoms in A and B interfere with your life?

A60
Criteria A, B, C, D, E, F, G, and H are "-".

(Make a diagnosis of 300.4 Dysthymic Disorder)
A. Mood Episodes

CONSIDER ETIOLOGICAL ROLE OF A GENERAL MEDICAL CONDITION OR SUBSTANCE USE

If mood symptoms are not temporally associated with a general medical condition, go to A65, page 22 (Substance-Induced Mood Disorder).

MOOD DISORDER DUE TO A GENERAL MEDICAL CONDITION

CODE BASED ON INFORMATION ALREADY OBTAINED

A61

CRITERIA FOR MOOD DISORDER DUE TO A GENERAL MEDICAL CONDITION

NOTE: Criterion D (i.e., not during delirium) has been omitted from the SCID.

A. A prominent and persistent disturbance in mood predominant in the clinical picture and by either (or both) of the following:

1. Depressed mood or markedly diminished interest or pleasure in all, or almost all, activities

2. Elevated, expansive, or irritable mood

A61

Do you think your [MOOD SYMPTOMS] were in any way related to your [COMORBID GENERAL MEDICAL CONDITION]?

IF YES: Tell me how.

(1) Depressed mood or markedly diminished interest or pleasure in all, or almost all, activities

(2) Elevated, expansive, or irritable mood

A62

B/C. There is evidence from the history, physical examination, or laboratory findings that the disturbance is the direct physiological consequence of a general medical condition, and the disturbance is not better accounted for by another mental disorder (e.g., Adjustment Disorder With Depressed Mood in response to the stress of having a general medical condition).

A62

If A62 is "-" (general medical condition not etiological), go to A65, page 22 (Substance-Induced Mood Disorder).
SCID-CV Administration Booklet

A. Mood Episodes

A63 IF UNCLEAR: How much did [MOOD SYMPTOMS] interfere with your life?

E. The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

A64 IF UNKNOWN: Have you had [SYMPTOMS RATED "+" ABOVE] in the past month?

CRITERIA A, B/C, AND E ARE "+"

(MAKE A DIAGNOSIS OF 295.33 MOOD DISORDER DUE TO A GENERAL MEDICAL CONDITION)

If mood symptoms are not temporally associated with substance use, return to episode being evaluated:

A12 for Major Depressive Episode (page 6)
A27 for Manic Episode (page 11)
A42 for Hypomanic Episode (page 15)
A58 for Dysthymic Disorder (page 19)
D11 for Other Bipolar Disorders (page 49)
D18 for Depressive Disorder NOS (page 52)
A. Mood Episodes

SUBSTANCE-INDUCED MOOD DISORDER

CODE BASED ON INFORMATION ALREADY OBTAINED

A65

IF UNKNOWN: When did the [MOOD SYMPTOMS] begin? Were you already using [SUBSTANCE] or had you just stopped or cut down your use?

A66

CRITERIA FOR SUBSTANCE-INDUCED MOOD DISORDER

NOTE: Criterion D (i.e., not due to delirium) has been omitted from the SCID.

A. A prominent and persistent disturbance in mood predominant in the clinical picture and characterized by either (or both) of the following:

(1) depressed or markedly diminished interest or pleasure in all, or almost all, activities

(2) elevated, expansive, or irritable mood

B. There is evidence from the history, physical examination, or laboratory findings of either (1) or (2)

(1) the symptoms in criterion A developed during, or within a month of, Substance Intoxication or Withdrawal

(2) medication use is etiologically related to the disturbance

A67

Do you think your [MOOD SYMPTOMS] are in any way related to your [SUBSTANCE USE]? If YES: Tell me how.

ASK ANY OF THE FOLLOWING QUESTIONS AS NEEDED TO RULE OUT A NONSUBSTANCE ETIOLOGY

C. The disturbance is not better accounted for by a Mood Disorder that is not substance induced. Evidence that the symptoms are better accounted for by a Mood Disorder that is not substance induced might include:
**SCID-CV Administration Booklet**

**A. Mood Episodes**

<table>
<thead>
<tr>
<th>Question</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A67</strong> (Mark)</td>
<td>(1) the mood symptoms precede the onset of the substance use (or medication use)</td>
</tr>
<tr>
<td>IF UNKNOWN: Which came first, the [SUBSTANCE USE] or the [MOOD SYMPTOMS]?</td>
<td>(2) the mood symptoms persist for a substantial period of time (e.g., about a month) after the cessation of acute withdrawal or severe intoxication</td>
</tr>
<tr>
<td>IF UNKNOWN: Have you had a period of time when you stopped using [SUBSTANCE]?</td>
<td>(3) the mood symptoms are substantially in excess of what would be expected given the type or amount of the substance used or the duration of use</td>
</tr>
<tr>
<td>IF YES: After you stopped using [SUBSTANCE], did the [MOOD SYMPTOMS] get better?</td>
<td>(4) there is other evidence that suggests the existence of an independent non-substance-induced Mood Disorder (e.g., a history of recurrent non-substance-related Major Depressive Episodes)</td>
</tr>
<tr>
<td>IF UNKNOWN: How much of [SUBSTANCE] were you using when you began to have [MOOD SYMPTOMS]?</td>
<td></td>
</tr>
<tr>
<td>IF UNKNOWN: Have you had any other episodes of [MOOD SYMPTOMS]?</td>
<td></td>
</tr>
<tr>
<td>IF YES: How many? Were you using [SUBSTANCE] at those times?</td>
<td></td>
</tr>
</tbody>
</table>

**If A67 is “—” (i.e., the disturbance is better accounted for by a non-substance-induced Mood Disorder), then return to episode being evaluated:**

- A12 for Major Depressive Episode (page 6)
- A27 for Manic Episode (page 11)
- A42 for Hypomanic Episode (page 15)
- A58 for Dysthymic Disorder (page 19)
- D11 for Other Bipolar Disorders (page 49)
- D18 for Depressive Disorder NOS (page 52)

**A68** IF UNKNOWN: How much did [MOOD SYMPTOMS] interfere with your life?

**A69** IF UNKNOWN: Have you had [SYMPTOMS RATED “+” ABOVE] in the past month?

**CRITERIA A, B, C, AND E ARE “+”**

(MAKE A DIAGNOSIS OF SUBSTANCE-INDUCED MOOD DISORDER)

Return to episode being evaluated:

- A12 for Major Depressive Episode (page 6)
- A27 for Manic Episode (page 11)
- A42 for Hypomanic Episode (page 15)
- A58 for Dysthymic Disorder (page 19)
- D11 for Other Bipolar Disorders (page 49)
- D18 for Depressive Disorder NOS (page 52)
Appendix Q: Young Mania Rating Scale (Clinician-Rated)

**Young Mania Rating Scale (YMRS)**

**Instructions:** For each item below, circle the response that best describes how you felt or behaved during the past 48 hours.

<table>
<thead>
<tr>
<th>1. Elevated Mood</th>
<th>7. Language/Thought Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Mildly or possibly increased</td>
<td>Circumstantial; mild distractibility; quick thoughts</td>
</tr>
<tr>
<td>Definite subjective elevation; optimistic; self-confident; cheerful; appropriate to content</td>
<td>2. Distractible; loses goal of thought; changes topics frequently; racing thoughts</td>
</tr>
<tr>
<td>Elevated, inappropriate to content; humorous</td>
<td>3. Flight of ideas; tangentiality; difficult to follow; rhyming; echolalia</td>
</tr>
<tr>
<td>Euphoric; inappropriate laughter, singing</td>
<td>4. Incoherent; communication impossible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Increased Motor Activity/Energy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Subjectively increased</td>
<td>Circumstantial; mild distractibility; quick thoughts</td>
</tr>
<tr>
<td>Animated; gestures increased</td>
<td>Distractible; loses goal of thought; changes topics frequently; racing thoughts</td>
</tr>
<tr>
<td>Excessive energy; hyperactive at times; restless (can be calmed)</td>
<td>Flight of ideas; tangentiality; difficult to follow; rhyming; echolalia</td>
</tr>
<tr>
<td>Motor excitement; continuous hyperactivity (cannot be calmed)</td>
<td>Incoherent; communication impossible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Sexual Interest</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal; not increased</td>
<td>Absent, cooperative</td>
</tr>
<tr>
<td>Mildly or possibly increased</td>
<td>Sarcasm, loud at times, guarded</td>
</tr>
<tr>
<td>Definite subjective increase on questioning</td>
<td>Demanding; threats on ward</td>
</tr>
<tr>
<td>Spontaneous sexual content; elaborates on sexual matters; hypersexual by self-report</td>
<td>Threatens interviewer; shouting; interview difficult</td>
</tr>
<tr>
<td>Overt sexual acts (toward patients, staff, or interviewer)</td>
<td>Assaultive; destructive; interview impossible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Sleep</th>
<th>10. Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reports no decrease in sleep</td>
<td>Appropriate dress and grooming</td>
</tr>
<tr>
<td>Sleeping less than normal amount by up to one hour</td>
<td>Minimally unkempt</td>
</tr>
<tr>
<td>Sleeping less than normal by more than one hour</td>
<td>Poorly groomed; moderately disheveled; overdressed</td>
</tr>
<tr>
<td>Reports decreased need for sleep</td>
<td>Disheveled; partly clothed; garish makeup</td>
</tr>
<tr>
<td>Denies need for sleep</td>
<td>Completely unkempt; decorated; bizarre garb</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Irritability</th>
<th>11. Insight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>Present; admits illness; agrees with need for treatment</td>
</tr>
<tr>
<td>Subjectively increased</td>
<td>Possibly ill</td>
</tr>
<tr>
<td>Irritable at times during interview; recent episodes of anger or annoyance on ward</td>
<td>Admits behavior change, but denies illness</td>
</tr>
<tr>
<td>Frequently irritable during interview; short or curt throughout</td>
<td>Admits possible change in behavior; but denies illness</td>
</tr>
<tr>
<td>Hostile, uncooperative; interview impossible</td>
<td>Denies any behavior change</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Speech (Rate and Amount)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No increase</td>
<td>Present; admits illness; agrees with need for treatment</td>
</tr>
<tr>
<td>Feels talkative</td>
<td>Possibly ill</td>
</tr>
<tr>
<td>Increased rate or amount at times, verbose at times</td>
<td>Admits behavior change, but denies illness</td>
</tr>
<tr>
<td>Push; consistently increased rate and amount; difficult to interrupt</td>
<td>Admits possible change in behavior; but denies illness</td>
</tr>
<tr>
<td>Pressured; uninterruptible, continuous speech</td>
<td>Denies any behavior change</td>
</tr>
</tbody>
</table>
Appendix R: Beck Depression Inventory-II

<table>
<thead>
<tr>
<th>1. Sadness</th>
<th>6. Punishment Feelings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 I do not feel sad.</td>
<td>0 I don’t feel I am being punished.</td>
</tr>
<tr>
<td>1 I feel sad much of the time.</td>
<td>1 I feel I may be punished.</td>
</tr>
<tr>
<td>2 I am sad all the time.</td>
<td>2 I expect to be punished.</td>
</tr>
<tr>
<td>3 I am so sad or unhappy that I can’t stand it.</td>
<td>3 I feel I am being punished.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Pessimism</th>
<th>7. Self-Dislike</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 I am not discouraged about my future.</td>
<td>0 I feel the same about myself as ever.</td>
</tr>
<tr>
<td>1 I feel more discouraged about my future than I used to be.</td>
<td>1 I have lost confidence in myself.</td>
</tr>
<tr>
<td>2 I do not expect things to work out for me.</td>
<td>2 I am disappointed in myself.</td>
</tr>
<tr>
<td>3 I feel my future is hopeless and will only get worse.</td>
<td>3 I dislike myself.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Past Failure</th>
<th>8. Self-Criticalness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 I do not feel like a failure.</td>
<td>0 I don’t criticize or blame myself more than usual.</td>
</tr>
<tr>
<td>1 I have failed more than I should have.</td>
<td>1 I am more critical of myself than I used to be.</td>
</tr>
<tr>
<td>2 As I look back, I see a lot of failures.</td>
<td>2 I criticize myself for all of my faults.</td>
</tr>
<tr>
<td>3 I feel I am a total failure as a person.</td>
<td>3 I blame myself for everything bad that happens.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Loss of Pleasure</th>
<th>9. Suicidal Thoughts or Wishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 I get as much pleasure as I ever did from the things I enjoy.</td>
<td>0 I don’t have any thoughts of killing myself.</td>
</tr>
<tr>
<td>1 I don’t enjoy things as much as I used to.</td>
<td>1 I have thoughts of killing myself, but I would not carry them out.</td>
</tr>
<tr>
<td>2 I get very little pleasure from the things I used to enjoy.</td>
<td>2 I would like to kill myself.</td>
</tr>
<tr>
<td>3 I can’t get any pleasure from the things I used to enjoy.</td>
<td>3 I would kill myself if I had the chance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Guilty Feelings</th>
<th>10. Crying</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 I don’t feel particularly guilty.</td>
<td>0 I don’t cry anymore than I used to.</td>
</tr>
<tr>
<td>1 I feel guilty over many things I have done or should have done.</td>
<td>1 I cry more than I used to.</td>
</tr>
<tr>
<td>2 I feel quite guilty most of the time.</td>
<td>2 I cry over every little thing.</td>
</tr>
<tr>
<td>3 I feel guilty all of the time.</td>
<td>3 I feel like crying, but I can’t.</td>
</tr>
</tbody>
</table>
Appendix S: Internal States Scale

INTERNAL STATE SCALE (v.2)

For each of the following statements, please circle on the line that best describes the way you have felt over the past 24 hours. While there may have been some change during that time, try to give a single summary rating for each item.

Today my mood is changeable.

0 □ □ □ □ □ □ □ □ □ 100
Not at all Rarely
Very much so Much of the time

Today I feel irritable.

0 □ □ □ □ □ □ □ □ □ 100
Not at all Rarely
Very much so Much of the time

Today I feel like a capable person.

0 □ □ □ □ □ □ □ □ □ 100
Not at all Rarely
Very much so Much of the time

Today I feel like people are out to get me.

0 □ □ □ □ □ □ □ □ □ 100
Not at all Rarely
Very much so Much of the time

Today I actually feel great inside.

0 □ □ □ □ □ □ □ □ □ 100
Not at all Rarely
Very much so Much of the time

Today I feel impulsive.

0 □ □ □ □ □ □ □ □ □ 100
Not at all Rarely
Very much so Much of the time
Appendix T: Automated Ospan (Example)

1. $5+4/3=9$ “YES OR NO?” POD
2. $3+6-3=3$ “YES OR NO?” PAN
3. $5+9/2=7$ “YES OR NO?” RAT
4. $3\times7-4=20$ “YES OR NO?” BAG
5. $5/5-1=0$ “YES OR NO?” CAR
6. $4\times1-2=2$ “YES OR NO?” PIT
7. $3-1+4=6$ “YES OR NO?” MIT
8. $2+7-4=4$ “YES OR NO?” OAK
9. $1+9-5=5$ “YES OR NO?” MAN
10. $2+5-7=0$ “YES OR NO?” DOG

“TYPE ALL WORDS PRESENTED”
Appendix U: “Thinking and Feeling” Task Screenshots
Thinking Task

Does \((3 \times 3) / 6 - 1\) ?

Yes
No

Word Recall

Enter the words in the spaces below. Click on a space to open the keyboard.

1.  
2.  
3.  
4.  
5.  
6.  
7.  
8.  
9.  
10. 

Done
**Appendix V: Summary of Internal States Scale Items (Bauer et al, 2000)**

<table>
<thead>
<tr>
<th>Item Text</th>
<th>Subscale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Today my mood is changeable</td>
<td>Perceived</td>
</tr>
<tr>
<td>Today I feel initiative</td>
<td>Conflict</td>
</tr>
<tr>
<td>Today I feel like a capable person</td>
<td>Well Being</td>
</tr>
<tr>
<td>Today I feel like people are out to get me</td>
<td>Perceived</td>
</tr>
<tr>
<td>Today I actually feel great inside</td>
<td>Conflict</td>
</tr>
<tr>
<td>Today I feel nervous</td>
<td>Well Being</td>
</tr>
<tr>
<td>Today I feel depressed</td>
<td>Activation</td>
</tr>
<tr>
<td>Today my thoughts are going fast</td>
<td>Depression Index</td>
</tr>
<tr>
<td>Today it seems like nothing will ever work out for me</td>
<td>Activation</td>
</tr>
<tr>
<td>Today I feel overactive</td>
<td>Depression Index</td>
</tr>
<tr>
<td>Today I feel as if the world is against me</td>
<td>Perceived</td>
</tr>
<tr>
<td>Today I feel ‘speed up’ inside</td>
<td>Activation</td>
</tr>
<tr>
<td>Today I feel restless</td>
<td>Activation</td>
</tr>
<tr>
<td>Today I feel argumentative</td>
<td>Perceived</td>
</tr>
<tr>
<td>Today I feel energized</td>
<td>Conflict</td>
</tr>
<tr>
<td></td>
<td>Well Being</td>
</tr>
</tbody>
</table>
Appendix W: Exploratory Measures of Mood State

For follow-up exploratory analyses, various strategies for classification of overall mood state at each measurement trial occurred, based on receiver operating characteristics (ROC). Thus, if a participant had a “high” overall mood state score (defined by one standard deviation above their mean score), they were said to be in a depressed mood state, for a particular measurement trial. If a participant had a “low” overall mood state score (defined by one standard deviation below their mean score), they were said to be in a manic mood state, for a particular measurement trial. Various cut-off scores were examined to evaluate their differential correlations with working memory capacity.

Exploratory Measurement of Mixed Mood State. One of the goals in post-dissertation analyses was to identify a mixed “anxious-depressed” mood state that may occur during a measurement trial, and examine the possible relations between this mood state and working memory capacity. Bauer et al (2000) theorized that high scores on the Activation Scale and low scores on the Well-Being scale concurrently could predict a mixed-mood state, when compared to clinician ratings (e.g. “I feel overactive” endorsed with a high score, and “I feel great,” endorsed with a very low score). Exploratory analyses were used to test this hypothesis. The principle investigator categorized data at a measurement trial that follow this response pattern into a “mixed mood state,” for each participant. This was done by ROC curves to estimate the most effective cut-off scores on the two scales for each participant. Once cut-off scores were obtained for each

29 If participants had high scores on the Well-Being scale and concurrently low scores on the Depression Index, this measurement trial was not counted. This would be an example of “inconsistent reporting,” (e.g. a participant endorses both “I feel depressed,” and “I feel great inside” with high scores, currently, for a sampling period).
participant, data that fall within the cut-off scores will be placed into the mixed mood state category. This strategy was previously demonstrated by Bauer (2000). After this categorization is completed, the possible relations between participants’ working memory capacity and mixed mood state were explored.30

Exploratory Measure of Mood State Duration. In the literature, there is no precedent for measuring the duration of a mood state (e.g. how long a mood state lasts). Various strategies for estimating duration of mood states were tested in post-dissertation analyses. The correlation between mood duration measures and working memory capacity was examined.

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30 Using a similar technique, classification between manic and hypomanic mood state occurred in post-dissertation analyses, based on scores on the Activation Scale and Well-Being Scale (also previously examined by Bauer, (2000)). Then, the possible associations between hypomanic mood state and working memory capacity were explored.