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Few studies have examined the presence or impact of anhedonia in the hedonic experiences of daily life in people with depression, with the majority of studies on anhedonia and depression being single time-point questionnaire studies or laboratory-based experimental studies. This study combined a sensory hedonic response task with daily diary methodology in order to examine the link between depressive symptoms and hedonic response of wanting and liking in both a laboratory setting and in everyday life. Ninety undergraduates participated in a 3-part study, which took place over the course of 10 days. Students completed questionnaires online, followed by an in-lab tasting task, in which they tasted several samples of chocolate and bland crackers, after which they completed nightly surveys for a total of seven days, reporting on their experiences of seemingly pleasant things that day, and predicting how they would feel the next day about similar events. Using regression and structural equation modeling, we examined whether depressive symptoms predicted how much students would anticipate their hedonic response to typically pleasant events. We then examined the difference between how much they anticipated feeling at those events, and how much they actually felt during those events, looking for a predictive effect of depression on the gap between anticipation and experience. Only in the daily diary task did depression symptoms predict how much a person would anticipate pleasant events the next day, such that those with

higher depression anticipated enjoying themselves less than those with fewer depression symptoms.

WANTING AND LIKING: THE EFFECTS OF DEPRESSIVE SYMPTOMS  
AND ANHEDONIA ON HEDONIC RESPONSES TO A  
LABORATORY TASK AND IN EVERYDAY LIFE

by

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Approved by

Kari M. Eddington  
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In loving memory of my grandparents,  
Kermit E. Larson (1924-2015), Helen M. Larson (1922-2018),  
and Eileen M. Maloney (1908-2006).

APPROVAL PAGE

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## TABLE OF CONTENTS

	Page
LIST OF TABLES .....	vii
CHAPTER	
I. INTRODUCTION .....	1
Conceptualization of Anhedonia.....	3
Operationalizing Anhedonia and Finding a Gap in the Literature.....	13
Goals and Hypotheses.....	15
II. METHODS .....	17
Participants/Subjects.....	17
Materials .....	18
Procedures.....	21
Data Analytic Strategy and Missing Data .....	22
III. RESULTS .....	26
Task Effectiveness of Chocolate Tasting.....	26
Wanting: Predictive Effect of Depression Symptoms on Hedonic Response.....	26
Predictive Effect of Depression Symptoms on Discrepancy Between Wanting and Liking .....	27
IV. DISCUSSION .....	29
Hypothesis 1.....	29
Hypothesis 2.....	31
Limitations of the Study.....	32
Strengths .....	34
Conclusions and Future Directions.....	35
REFERENCES .....	38
APPENDIX A. TABLES .....	49

APPENDIX B. MEASURES AND MATERIALS.....54

## LIST OF TABLES

	Page
Table 1. Measures for Hypothesis 1 in the Sensory Hedonic Response Lab Task and Daily Diary .....	49
Table 2. Measures for Hypothesis 2 in the Sensory Hedonic Response Lab Task and Daily Diary .....	50
Table 3. Descriptives for Pre-Lab Questionnaires and Anticipated and Experienced Hedonic Response Scores .....	51
Table 4. Correlations Between Pre-Lab Questionnaires and Anticipated and Experienced Hedonic Response Scores .....	52
Table 5. Descriptives for Daily Diary Variables.....	53

## CHAPTER I

### INTRODUCTION

Anhedonia is a transdiagnostic construct that is reported to be present in various disorders, including psychotic disorders, mood disorders, anxiety disorders, trauma-related disorders, eating disorders and substance use disorders, though it is most thoroughly-studied as a negative symptom in schizophrenia (Ritsner, 2014; Rizvi, Pizzagalli, Sproule, & Kennedy, 2016; Shankman et al., 2014). In schizophrenia, as with other disorder, anhedonia is a symptom that is often reported as resistant to treatment, which has led to the wealth of data that has been collected on anhedonia in schizophrenia (Shankman et al., 2014). In depression, anhedonia is one of the two hallmark symptoms of MDD, according to the Diagnostic and Statistical Manual of Mental Disorders-5<sup>th</sup> edition (*DSM-5<sup>TM</sup>*, 2013), and it is one of the three key symptoms according to the WHO International Classification of Diseases-10 (World Health Organization., 1992). Buchwald and Rudick-Davis (1993) report that more than two-thirds of people with MDD have symptoms of anhedonia, with Yorbik et al., (Yorbik, Birmaher, Axelson, Williamson, & Ryan, 2004) reporting 74% of depressed adolescents reporting the symptom, and studies have shown that it is a poor prognostic indicator for depression (Auerbach, Millner, Stewart, & Esposito, 2015; Gotlib et al., 2010; Gwenolé Loas, 1996; McMakin et al., 2012; Pelizza, Pupo, & Ferrari, 2012; Pizzagalli, Iosifescu, Hallett,

Ratner, & Fava, 2008; R. Uher et al., 2012; Yaseen, Galynker, Briggs, Freed, & Gabbay, 2016).

Not only is anhedonia a symptom of active depression, but it is also a risk factor for depression, thought to increase vulnerability for developing the disorder (Gotlib et al., 2010; Liu et al., 2016; Gwenolé Loas & Boyer, 1996; Pelizza et al., 2012; Pizzagalli et al., 2008). Large-scale research on depression, such as the Genome Based Therapeutic Drugs for Depression (GENDEP) study and the Sequenced Treatment Alternatives to Relieve Depression (STAR\*D) study (Warden, Rush, Trivedi, Fava, & R Wisniewski, 2008), has shown that anhedonia is strongly predictive of poorer treatment outcomes, including non-response to antidepressants and rTMS (Uher et al., 2012; Uher et al., 2009). In an adolescent study of treatment-resistant youth, anhedonia scores were a negative predictor of time to remission and depression-free days (McMakin et al., 2012). Anhedonia also greatly increases the risk that a person with MDD will attempt or complete suicide (Auerbach et al., 2015; G. Loas, Perot, Chignague, Trespalacios, & Delahousse, 2000; Yaseen et al., 2016). Children and adolescents who report having anhedonia are also at increased risk of suicidal behaviors, with greater anhedonia differentiating between those with suicidal ideation versus those who attempt suicide (Auerbach et al., 2015; Nock & Kazdin, 2005). In general, these and other studies support the idea that anhedonia is both a risk factor for depression as well as a possible indicator of long-term course and prognosis of depression.

As with all potential symptomology, whether or not and how much it interferes with a person's daily life experiences and activities are determining factors in its being considered a pathological symptom. Given its presence in multiple disorders, such as schizophrenia and depression, it follows that anhedonia could be described as a multifaceted clinical symptom that is associated with poorer treatment outcomes and increased safety risks. The potential negative impact of anhedonia on the lives of so many people also justifies the further study of anhedonia, to discover the differences and similarities in presentation of anhedonic symptoms, as well as to distinguish between different facets of anhedonia.

### **Conceptualization of Anhedonia**

When trying to understand what role a construct such as anhedonia plays in disorders like MDD, it is important to evaluate and consider all possible conceptual elements of that construct in order to better understand and develop hypotheses about potential mechanisms of action. Before we can explain why different individuals, or groups of individuals, differ in their response to similar life events, we have to understand what typical responses look like, examine how atypical responses are different, and identify the more nuanced components of the two.

**Reward Responsiveness.** Much of human behavior can be examined in the context of engaging in actions that lead to rewards, or rewarding outcomes, that fulfill a need or desire. Anhedonia is frequently described as a deficiency within the reward circuitry, resulting in a reduced or blunted response to typically pleasurable stimuli. Gold

(2008) found that this reduction in, or lack of, responsiveness to such stimuli in those with anhedonic symptoms of depression are less likely to report enjoyment from certain experiences as healthy controls. Studies have also shown that the blunted reward responsiveness is not only a hallmark of active depressive symptoms, but also persists after remission from depressive symptoms, and has even been found in first degree relatives of people with depression (Liu et al., 2016), suggesting that blunted reward response might be an indicator of risk of developing depression.

Research has shown that those with increased levels of depression and anhedonia have a diminished response to rewards, which has taken the form of blunted, diminished hedonic response to a variety of laboratory tasks, such as responses to pleasant imagery (Allen, Trinder, & Brennan, 1999; Sloan, Strauss, Quirk, & Sajatovic, 1997), positive emotion faces (Bylsma, Morris, & Rottenberg, 2008) and films (Berenbaum H, Snowwhite R, Oltmanns TF., 1987; Kaviani et al., 2004; Rottenberg, Kasch, Gross, & Gotlib, 2002), pleasant words (Mathews & Barch, 2006) and monetary reward contingencies such as gambling paradigms (Steele, Kumar, & Ebmeier, 2007). Gotlib et al. (2010), showed that familial risk for depressive symptoms resulted in anomalies in reward processing in adolescents, despite not yet having developed any symptoms of depression themselves.

In their study, Chenstova-Dutton and Hanley (Chentsova-Dutton & Hanley, 2010; Hanley, n.d.) measured the hedonic responses of undergraduate students by administering a taste-test with chocolate samples and bland foods. They measured the anticipation, experience and recall of the experience of eating chocolate and compared the resulting

scores with measures of depressive symptoms. Those researchers found that anhedonia and depressive symptoms in an undergraduate population predicted lower, but more accurate, levels of anticipation to the hedonic response task.

Research examining reward responsiveness is helpful in beginning to conceptualize anhedonia in the context of a common mechanism or pathway that might be malfunctioning. Different types of laboratory tasks, such as those mentioned above, have begun to identify specific differences between typical and atypical functioning, though they are limited to the parameters of the lab as well as the intervention or measure being used. These limitations are driven by the different elements that make up a construct such as anhedonia, which in turn make it difficult to draw conclusions or generalize the results of such studies to explain broader functioning.

**Wanting vs. Liking.** The term anhedonia was coined in 1896 by Ribot<sup>1</sup>, meaning loss of pleasure, to differentiate it from analgesia, meaning a loss of feeling of pain. However, this definition focuses primarily on the consummatory hedonic experiences – the experience of liking or enjoyment – and does not encompass the different facets of anhedonia. Similarly, some early measures of anhedonia, like the Fawcett-Clark Pleasure Scale (FCPS; Fawcett, Clark, Scheftner, & Gibbons, 1983) and the Snaith-Hamilton Pleasure Scale (SHAPS; Snaith et al., 1995), focused solely on consummatory hedonic

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<sup>1</sup> Ribot first introduces the term “anhedonie” in his book, *‘La psychologie des sentiments’* which was published in 1896, and was translated into English in 1897 as “anhedonia” in *‘The Psychology of the Emotions’*.

experiences, neglecting, for example, the interest a person feels leading up to an experience, also known as anticipation, or wanting (Rizvi et al., 2016, 2015).

Treadway and Zald (2011, 2013) describe the distinction between what they refer to as “motivational anhedonia”—meaning a lack of energy or interest in a future experience, just as in anticipatory anhedonia—and consummatory anhedonia, being a blunted affective response to the experience itself. Treadway and Zald (2013) go on to present anticipation and consumption as two distinct aspects of reward processing, resulting from separate underlying neural mechanisms. This distinction between anticipatory and consummatory anhedonia has been supported by other researchers (Chentsova-Dutton & Hanley, 2010; Rizvi et al., 2016; Shankman et al., 2014; Sherdell, Waugh, & Gotlib, 2012), including animal and imaging studies (Chan et al., 2012). The difference between wanting and liking is an important consideration when evaluating appropriate measures of anhedonia in order to capture the fuller scope of loss of pleasure. To date, the only measure that has subscales that propose to differentiate between anticipatory and consummatory anhedonia is the Temporal Experiences of Pleasure Scale, or TEPS, published by Gard, Gard, Kring and John, in 2006. Validation studies have been conducted on the TEPS in healthy control and undergraduate samples, as well as clinical samples of patients with schizophrenia, schizoaffective disorder and opioid use disorders. One study examining the validity of a French translation of the TEPS did a comparison of healthy, schizophrenic and non-schizophrenic psychiatric samples (G.

Loas et al., 2009). However, lab tasks have more frequently assessed wanting and liking separately.

Several lab studies such as those by Shankman (2014), Gotlib (2010), and Sherdell (2012) have shown that, across lab tasks, the hedonic symptom most clearly related to depression is the wanting – anticipatory anhedonia. Interestingly, research has shown repeatedly that when individuals self-report their level of anticipation for a reward, those with MDD report lower hedonic scores, but that when their consummatory pleasure scores are measured, they actually report enjoying the reward as much as the healthy controls. In partial contrast, some studies have shown the same lowered anticipation for hedonic events, but showed a higher level of hedonic responses than was anticipated, while still scoring significantly lower compared with healthy controls. Additionally, as previously mentioned, this dampened hedonic response continued after depression remitted for a sub-set of participants (Clark, 1984).

**Social & Physical Domains of Anhedonia.** Another important distinction to consider is the difference between domains of anhedonia. A distinction between the experience of anhedonia related to social experiences versus physical experiences of anhedonia goes back to the beginnings of the term anhedonia when Ribot described scenarios depicting social anhedonia and physical anhedonia (1896), with the Chapman scales being the first to measure anhedonia separately (Chapman, Chapman, & Raulin, 1976). *Social anhedonia* is the loss of such feelings in social situations, often leading to impaired ability to relate to others and feelings of social isolation (Chapman et al., 1976;

Shankman et al., 2014). *Physical anhedonia*, or sensory anhedonia, is the loss or lack of pleasure in things that stimulate the five senses: smell, sight, touch, sound, and taste. The two most commonly studied sensory anhedonias are loss of sexual interest, which also likely has a social component, and loss of gustatory pleasure (Shankman, 2014).

As previously mentioned, anhedonia is known to be one of the core negative symptoms of schizophrenia, first identified by Kraepelin and Bleuler (Mishlove & Chapman, 1985) in the early 20<sup>th</sup> century. They observed not only a decreased sense of enjoyment at daily things among those with schizophrenia, but also an increase in social isolation and a decrease in meaningful relationships. In the 1950's and 60's, Rado, followed by Meehl (1962), further hypothesized that this decreased enjoyment, especially socially, led to increased isolation, impaired social functioning and impaired cognitive functioning (Blanchard, Bellack, & Mueser, 1994). While people with schizophrenia often score higher than controls on measures of both social and physical anhedonia, studies have shown that social anhedonia in particular is prodromal of psychotic disorders like schizophrenia, with trait-like social anhedonic characteristics predictive of the later emergence of the disorder (Atherton, Nevels, & Moore, 2015; Kwapil, Miller, Zinser, Chapman, & Chapman, 1997; Mishlove & Chapman, 1985). According to Rey (2009), social anhedonia is a better indicator of vulnerability to schizophrenia than physical anhedonia, when assessing Chapman scale scores (the first assessments created to measure anhedonia, published as separate physical and social anhedonia scales in 1976, and revised in 1982).

While social anhedonia is a well-known and much-studied symptom of schizophrenia, whether or not there is a difference between physical and social anhedonia within non-psychotic disorders is not clear. Many depression studies rely on measures that do not differentiate between the two anhedonias, while others look at only one type of anhedonia or the other. However, the fact that there is a marked difference within psychotic disorders suggests it is an area that needs further investigation, and measures that are specific enough to assess physical and/or social anhedonia.

Given that social hedonic experiences are harder to develop into a controlled experimental task, and only one construct can easily be tested at one time in such an experimental task, only physical hedonic responses will be captured in this portion of the study. However, it is important to capture a representative sample of everyday life events when measuring hedonic experiences, so the most successful study will include a measure that captures both designs.

**State vs. Trait.** Another component to the conceptualization of anhedonia is the difference between anhedonia as a state versus a trait. Depression is most often conceptualized as a significant change in interest and mood state lasting over a period of time and causing dysfunction, as opposed to being driven solely by personality traits which persists across time and mood states. While anhedonia is considered a symptom of depression (thereby suggesting it is a state characteristic), some evidence suggests that a person's anhedonic expression persist even into remission (Rizvi et al., 2015), suggesting a stable construct (trait characteristic). Clark (1984) conducted a study looking at clinical

outcomes of depressed inpatients seven months after admission, comparing those with anhedonia to those without, and looking at whether their pleasure capacity scores changed with recovery. The researchers found that, while two-thirds of their depressed sample remitted, the pleasure scores (using the FCPS) of those with anhedonia remained significantly lower than those without anhedonia when comparing only recovered subjects even into remission. These findings support the concept of anhedonia as a trait-like characteristic. More recently, similar research has shown a continued blunting to reward responsiveness among remitted depressed subjects (Pechtel, Dutra, Goetz, & Pizzagalli, 2013).

While there is some evidence for anhedonia as a stable construct (trait characteristic), it is more often referred to as a symptom of depression (a state characteristic), most notably as one of the primary criteria for the diagnosis of depression in the DSM-5 (*Diagnostic and statistical manual of mental disorders: DSM-5<sup>TM</sup>, 5th ed.*, 2013) and the ICD-10 (World Health Organization., 1992). Chapman (1976), who further explored Meehl's proposition that in some people anhedonia is a genetically-based precursor to schizophrenia (1962, 1972), also proposed that anhedonia in depression is much of the time a relatively transient state. Additionally, even those studies that show evidence for anhedonia as a trait-like characteristic also show evidence of anhedonia as a state-like symptom, with decreases in anhedonic symptoms with remission of depressive symptoms (Rizvi, 2015). Fawcett and Clark developed the FCPS as a way of looking for a deficiency in state-dependent pleasure capacity, considered to be specific of a subtype

of depression, according to D'haenen (1996). State measures may be more appropriate for the study of episodic conditions like depression, since they measure anhedonia at a specific point in time, whereas trait-dependent measures inquire about anhedonia “in general” or across a lifetime. Furthermore, scales aimed at assessing overall tendencies are not sensitive to a change in a person’s experience of anhedonia, such as when measuring antidepressant treatment efficacy from week to week (Rizvi et al., 2016), or when assessing contextual factors that might influence the hedonic reactions of people to daily life events.

That said, the studies that support a trait-like anhedonia construct may actually be identifying a sub-type of depression, more severe and more chronic than more commonly diagnosed depression (Loas 1996, Shankman 2010). Shankman et al. (2010) conducted a longitudinal study that showed that physical anhedonia stayed relatively stable during six follow-ups over the course of 20 years in subjects with MDD who were recruited from inpatient hospitals. The concept of anhedonia as a trait-like characteristic, possibly an indicator of a sub-category of depression, is further supported by neuro-imaging research such as the study by Dichter and colleagues (2010). Their research showed that increased activity in the frontal striatal pole, a brain region known to show dysfunction during reward processing in those with MDD, of remitted depressed patients was distinct from healthy controls and was predictive of an increased number of lifetime depressive episodes. Another study by McCabe and colleagues (2009) similarly found abnormal neural activation in the ventral striatum, a brain region also associated with reward

processing and positive experiences, associated with reward in those with remitted depression compared to healthy controls. These findings would suggest that facets of anhedonia, or an anhedonic-like process, are separable from depression. In the case of the state-trait question, it would seem prudent that studies looking to measure hedonic responses specific to depression should control for trait-like anhedonia.

Despite the substantial research into anhedonia in schizophrenia, the more recent research into anhedonia in depression, and the research looking at the reward pathway, there is a lot we don't know about anhedonia as a transdiagnostic psychological symptom. The majority of research on anhedonia has been conducted using questionnaires at one or two individual timepoints, or in the case of the reward responsiveness literature, experimental methodology to induce hedonic responses through the use of laboratory tasks. The distinct components of anhedonia mentioned above – wanting vs. liking, social and physical, state vs. trait – identify the more complex nature of anhedonia and reward circuitry, and highlight areas that need further exploration so that our conceptualization of anhedonia can be more complete. We have only increased the number of questions and proposed characteristics of anhedonia without knowing how, when, and why they appear and/or differ amongst different clinical populations. Additionally, it is not clear whether measures of anhedonia using single time-point questionnaire studies or laboratory tasks can accurately relate to the daily lived experience of anhedonia amongst different populations.

## **Operationalizing Anhedonia and Finding A Gap in the Literature**

Daily diary studies allow researchers the opportunity to assess individuals' daily lived experiences in close to real-time. Similar to the benefits of experience sampling, daily diary data has the increased potential of gathering more accurate experiential data from participants in their real-life context, due to the sometimes faulty delayed recall of experienced emotions and events, which is particularly relevant in the field of mental health (Ben-Zeev & Young, 2010; Myin-Germeys et al., 2018). Research has shown that people with depressive symptoms, as compared with healthy controls, showed poorer retrospective symptom recall (Ben-Zeev, 2010). That said, experimental design methodology is beneficial due to the ability to control the stimulus and the timing of the response, and not risk the effects dissipating too quickly, which would make it difficult to evaluate temporal sequencing. However, while there is research examining hedonic experiences in people with varying degrees of depressive symptoms using laboratory tasks, there is a significantly lesser amount of research using daily diary or experience sampling methodology.

**Daily Diary Studies/Daily Experiences.** Daily diary studies allow researchers to capture information from individuals across a span of time, allowing them to collect a wealth of data to analyze experiences in daily life.

To our knowledge, only two studies have employed daily diary or experience sampling methodology examining anhedonia as it correlates to depressive symptoms in daily life. One study, looking at a non-clinical sample of early and late adolescents from

the Netherlands, used an operational definition of anhedonia that only encompassed the consummatory experience (van Roekel et al., 2016). The second study evaluated recently experienced and anticipated future “uplifting events in everyday life” in undergraduate psychology students oversampled for depressive symptoms (Starr & Hershenberg, 2017). Both studies found that positive everyday life events resulted in an improvement in mood symptoms, even in participants who had elevated depressive symptoms, contrary to laboratory models of blunted reward processing. Further, the results from Starr & Hershenberg’s (2017) study was consistent with the literature that consummatory hedonic experiences are higher than anticipated in those with depressed symptoms. Starr & Hershenberg (2017) found mood improvement in both anticipatory and consummatory pleasurable activities. Further, van Roekel et al. (2016) found that, although adolescents with many depressive symptoms experience decreased positive affect and fewer positive events, they enjoyed those pleasurable daily life events just as much as those with fewer depressive symptoms.

Thus far, this paper has presented a broad picture of the research into anhedonia across different disorders, focused primarily on laboratory tasks and survey sampling, and a more specific look at the research conducted on anhedonia in relation to depressive symptoms, including the two known studies examining anhedonia and depressive symptoms using experience sampling methodology. However, there are no known studies that evaluate a laboratory task and daily life experiences of anhedonia. One benefit of such a combined study is that it allows for experimental control of the hedonic

experiences through the lab task, while the daily diary components add to the real-world applicability of the results to a larger population, thus increasing external validity.

Ultimately, though, this type of combined methodology could inform research to a much greater extent, by exploring how much experimental designs actually relate to daily lived experiences of anhedonic symptoms in relation to depressive symptoms. The proposed study seeks to fill that gap by presenting a lab-based induction of sensory pleasure, using the chocolate tasting paradigm mentioned above (Chentsova-Dutton & Hanley, 2010; Hanley, 2007), in combination with assessing daily experiences of anhedonia. Given that both of these methodologies will include the two sub-types of hedonic responses, anticipatory and consummatory, and that the daily diary will capture everyday life events that cover both the physical and social domains, the study is set up to be as comprehensive as possible with regards to the measurement and multi-faceted operationalization of anhedonia.

### **Goals and Hypotheses**

The primary goal of the present study is to examine anticipated and experienced pleasure of hedonic responses in relation to depressive symptoms, by using cross-methodology to examine anhedonia in the lab and in daily life. The study involves assessment of “real-life” hedonic experiences through a daily diary collected over seven days, as well as during a sensory experience laboratory task in a sample of college undergraduates, oversampling for higher levels of depressive symptoms. This study is part of a larger study on the measurement of hedonic responses. Choosing a task that

assesses a physical hedonic response task is, in part, driven by the difficulty of creating a task that would measure social hedonic responses. By choosing a sensory hedonic response task, the hope is that there will be a straightforward, clearly identifiable hedonic response that would not be confounded by other, unrelated variables, such as reaction speed, or engagement in a more cerebral activity. The laboratory task involves rating anticipated pleasure before tasting a piece of chocolate, then tasting it and rating the experienced pleasure. A chocolate-tasting task was selected as the sensory experiment because previous studies (Chentsova-Dutton, 2009; McCabe et al., 2009) looked at the effects of chocolate on anhedonia and hedonic responses in college undergraduates. Macht & Dettmer (2006) found an increase in sensory pleasure in a study assessing mood after consuming chocolate, as compared with those who had apples or no snack, suggesting chocolate to be an adequate stimulus to inducing a positive sensory experience.

It is hypothesized that (1) participants' higher levels of depression will predict lower levels of anticipated enjoyment of a) sensory hedonic experience in a lab task and b) daily life events, above and beyond trait anticipatory anhedonia. It is also hypothesized that (2) participants' higher levels of depression will predict a greater discrepancy between anticipation of and actual experience of enjoyment and pleasure in a) a sensory hedonic response task and b) daily life events, above and beyond trait anticipatory anhedonia.

## CHAPTER II

### METHODS

#### **Participants/Subjects**

Participants were recruited from the University of North Carolina at Greensboro (UNCG) Psychology Department through the Sona Systems cloud-based online recruitment tool. All participants were students in a psychology class and received course credit for participating in research.

Ninety participants ranged in age from 18 to 40 ( $M = 20.20$ ,  $SD = 3.50$ ), were 86.6% female ( $n = 84$ ), 12.4% male ( $n = 12$ ), and 1.0% other ( $n = 1$ ), and were 45.3% White/Caucasian ( $n = 44$ ), 37.1% Black/African American ( $n = 36$ ), 16.5% Hispanic/Latino ( $n = 16$ ), 9.7% Asian ( $n = 10$ ), and 5.2% Native American Indian or Alaska Native ( $n = 5$ ), with 15.5% ( $n = 15$ ) identified as 2 or more races/ethnicities. Oversampling for depression symptoms was conducted by inviting students who participated in the department mass screening research opportunity and scored  $\geq 1.5$  SDs higher than the average score on the Mini-Mood and Anxiety Symptom Questionnaire (mini-MASQ) anhedonic depression (AD) subscale to participate. The standard clinical cutoff score for depression is a score of  $\geq 16$ .

All participants were required to speak and read English to complete the requirements of the study. Participants received 5 Sona credits toward their course

requirement/bonus credit opportunity, after they completed the daily diary portion, if they had completed at least 3 of 7.

In order to determine what sample size would need to be collected, an a priori power analysis was conducted, using [www.rpsychologist.com/d3/NHST/](http://www.rpsychologist.com/d3/NHST/), seeking to determine what sample size would yield a power of 0.8, and  $\alpha$  of 0.05, using a two-tailed test. Based on previous studies evaluating depression and anticipatory anhedonic response, a moderate effect size of  $r = 0.30$  was used. This yielded a sample size of 87.

## **Materials**

All surveys were completed using Qualtrics (<https://www.qualtrics.com/>), a computerized data capture tool. Assessments during the pre-lab study day and during the 7 days of daily diary collection were completed online using a device of the participant's choice. Assessments during the lab visit took place on a lab computer accessing Qualtrics online.

The mini-MASQ, TEPS, Center for Epidemiologic Studies Depression Scale (CESD) and Anticipated Hedonic Response to the Lab Task were completed online within no more than 72 hours before their lab visit, as part of the pre-lab questionnaires.

**Mini-MASQ.** The Mini-MASQ (Casillas & Anna Clark, 2002; Clark & Watson, 1995; see Appendix;  $\alpha = .928$ ) is a 26-item questionnaire that measures anxiety and depression symptoms, which is consistent with the tripartite model proposed by Clark and Watson in 1991, and is measured on a 5-point Likert scale ranging from “not at all” to “extremely”. Three subscales can be derived, measuring anhedonic depression (AD),

general distress, and anxious arousal. The Mini-MASQ AD ( $\alpha = .915$ ) score was used to over-sample for anhedonic depression in the UNCG Psychology Department Mass Screening protocol.

**TEPS.** The TEPS (Gard et al., 2006; see Appendix;  $\alpha = .827$ ) is an 18-item questionnaire that measures consummatory and anticipatory anhedonia. The TEPS anticipatory (TEPS-Ant,  $\alpha = .812$ ) sub-scale allowed us to control for trait anhedonia and measure the effect of depression. The TEPS can also generate a consummatory anhedonia subscale (TEPS-Con,  $\alpha = .676$ ), and is measured with a 6-point Likert scale ranging from “very false for me” to “very true for me”.

**CESD.** The CESD (Lewinsohn, Seeley, Roberts, & Allen, 1997; see Appendix;  $\alpha = .931$ ) was used to measure depression on a 4-point Likert scale, with answers ranging from “Rarely or none of the time (less than 1 day)” to “most or all of the time (5-7 days). Leventhal et al. (2014) found that the CESD was weakly correlated with the TEPS ( $r = 0.14$ ), which allowed us to separate depression from state-dependent anhedonia scores (Leventhal, 2014).

**Anticipated Hedonic Response to the Lab Task.** Reported intensity of anticipated hedonic response was measured by asking participants indicate their anticipated emotions of pleasure, boredom and satisfaction to potential research tasks, such as solving puzzles or filling out paperwork using a 9-point zero to eight Likert rating scale, per the Chentsova-Dutton (2009) study. The anticipated hedonic response score is

generated from the question asking participants to rate how much pleasure they would anticipate if they were to eat chocolate. (See Appendix.)

**Lab Task Measure of Experienced Hedonic Response.** During the lab task, participants were asked to rate each of five food samples using the same one to nine scale as above, using each of eight taste terms: the food tasted good\*, bitter, bland, sweet, sour, “I would eat more”, “I didn’t like the food”, and “I enjoyed tasting this food”\*. The first and last items just referenced (denoted by the ‘\*’) were used to measure the hedonic response to the food samples. See Appendix.

**Daily Diary Capture of Daily Experiences of Hedonic Response.** Participants reported their daily experiences of hedonic response in four steps, First, participants completed a day reconstruction, wherein they reported various experiences from the day, essentially replaying the day (see Appendix). Participants then rated how much they enjoyed certain activities that occurred today. Items were adapted from the SHAPS (Snaith et al., 1995; see Appendix), and included rating activities, such as work and socializing, on a Likert-type scale (e.g. “On a scale of one to five with one being ‘Not at all’ and five being ‘Extremely,’ please enter how much you agree with the following things that happened TODAY: ‘I found pleasure in a hobby or pastime.’”) After that, participants completed a distractor task which acted as a buffer between answers about the report of today’s hedonic response to activities from tomorrow’s prediction of hedonic response to activities, so that participants did not simply repeat their level of experience from today as their anticipation of experience for tomorrow. Finally,

participants answered questions aimed at assessing their anticipated enjoyment of the next day's activities, such as work and socializing, using the same adapted experiences from the SHAPS (e.g. "on a scale of zero to four with zero being 'I do not look forward to it at all,' and four being 'I am greatly looking forward to it,' please describe how you feel about your anticipated interactions with colleagues at work or classmates at school tomorrow"). See Appendix.

**Other Demographic Information.** All participants had basic demographic data collected during the first study day questionnaires, and were used for descriptive purposes.

### **Procedures**

Upon commencement of the pre-visit questionnaires (completed entirely online, within 72 hours of the lab task), participants provided informed consent, then completed measures of anhedonia and depression, followed by a measure of anticipated hedonic response. At the in-lab study visit, participants were first given a choice between milk or dark chocolate samples, and then presented with five unlabeled food samples, sequentially, which consisted of three small samples (approximately the size of a dime, so as to provide an adequate flavor experience, without reaching satiety) of chocolate (first, third, and fifth samples; Lindt®, Cadbury®, Dove®), presented in a fixed order, and two samples of bland food (a water cracker, second sample, and a rice cake, fourth sample). Instructions were given to: "Please take a small bite and take a moment to taste it on your tongue. When you are finished, please fill out the (first) questionnaire."

Participants then evaluated the sample using the hedonic experience rating scale on the computer in the lab. The food sample setup was arranged to provide a bland flavor between individual chocolate tastings, both to provide a control tasting and to partially cleanse their palates. After rating each food sample, participants were asked to take a sip of water, which also served to cleanse their palates. Any food allergies were assessed in the pre-lab surveys, and accommodations were made depending on the safety and comfort of the participant, such as offering only those chocolates that identified that they were manufactured in nut-free facilities, or by using a gluten-free cracker alternative to the water cracker.

After completing the experimental task, participants were instructed to fill out the daily diary surveys once every evening within a 3-hour window of being sent to them, so that they were filled out as consistently as possible throughout the week near the end of the day. At the end of the week, participants were awarded 5 credits through Sona for their entire participation in the study.

### **Data Analytic Strategy and Missing Data**

**Sensory Hedonic Response Task Data.** To assess the first part of Hypothesis 1, stepwise multiple regression was used to examine the predictive effects of the CESD on Ant-Choc, controlling for TEPS-Ant. To assess the first part of Hypothesis 2, stepwise multiple regression will again be used to assess the predictive effect of the CESD on discrepancy between anticipated hedonic response and experienced hedonic response ( $\text{Choc-Disc} = \text{Choc-Exp} - \text{Ant-Choc}$ ), controlling for TEPS-Ant. Experienced hedonic

response to the chocolate task is represented by the highest/best score on the chocolate tasting task.

**Daily Diary Data.** To examine the second part of Hypothesis 1, the micro-longitudinal design yielded a two-level structural equation model, with up to seven daily responses per person (Level 1, within-person), with their pre-lab CESD and TEPS-Ant scores as the between-person (Level 2) predictors of anticipated hedonic response to tomorrow's events ("Ant-Tom"). The second part of Hypothesis 2 was identical except for the dependent variable being the discrepancy score ('DD-Disc') calculated from the difference between the composite scores of all items calculated for 'Today' and 'Tomorrow' scales. All 'Today' and 'Tomorrow' scores were calculated adjusted for number of items answered "N/A", and/or diary days not completed. All daily diary data were analyzed using Mplus (8.1), with CESD and TEPS-Ant Grandmean centered.

**Discrepancy.** Discrepancy values were determined by finding the difference between the scores for the experienced hedonic response and the anticipated hedonic response. The number yielded represents the amount of difference between how the person expected to respond and how the person actually responded to the hedonic experience. Within the lab task, this was accomplished by subtracting the anticipated response score elicited on Pre-lab surveys of the study from the highest/best experienced hedonic response score from the chocolate tasting task. Within the daily diary, the discrepancy score was calculated by subtracting a participant's anticipated hedonic response (as measured on the 'Tomorrow' scale) from their actual, experienced hedonic

response the following day (as measured on the ‘Today’ scale). For example, ‘Tomorrow’ Day 2 was subtracted from ‘Today’ Day 3 to generate a discrepancy score between the anticipated and experienced responses. A larger positive value means that the participant’s actual enjoyment/pleasure was higher than what they anticipated, while a negative number indicates that the participant experienced less enjoyment/pleasure than they had anticipated.

**Highest/Best.** It was decided to examine the two hedonic experience questions on the lab task given for each chocolate sample, and utilize the highest/best score to run in the analysis as the ‘experienced’, or consummatory, hedonic response score. Because this study is examining a person’s anticipated response to a hedonic experience compared with their actual experienced hedonic response, it was deemed most appropriate to have the highest experienced positive hedonic response, especially given that people may respond differently to different chocolates (i.e. they may like some types of chocolate over others), rather than averaging the different responses to the three samples and using a composite score. Given that it is hypothesized that those suffering from depression have a reduced hedonic capacity (Pizzagalli et al., 2008) – the ability to experience pleasure from stimuli typically found to be rewarding – it would follow that the highest score on this task would yield the best indicator of such a person’s hedonic capacity in response to the chocolate sensory hedonic response task.

**Missing Data.** Due to technical difficulties, 12 participants were not administered the TEPS rating scale, and seven people were not administered the CESD

rating scale. Additionally, not all participants completed all seven days of the daily diary portion. Of the 97 participants who took part in the lab task, a total of 87 participants completed 3 or more days of daily diary surveys. In total there were 76 participants for whom there was sufficient daily diary data and all other required rating scales.

Discrepancies between the anticipated and experienced hedonic response to the chocolate task were able to be calculated on 97 individuals. Discrepancies were able to be calculated on 401 pairs of Anticipated and Experienced hedonic responses to daily life events, with the remaining 123 diary data points being unpaired due to a missing consecutive diary day or being the final diary day.

## CHAPTER III

### RESULTS

#### **Task Effectiveness of Chocolate Tasting**

To determine whether the chocolate-tasting task was effective at eliciting a hedonic response, a manipulation check was performed. A paired-samples t-test was conducted to compare the highest/best hedonic response to the chocolates ( $M = 6.90$ ,  $SD = 1.47$ ) to the highest/best hedonic response to the bland foods ( $M = 3.36$ ,  $SD = 1.96$ ). The chocolates elicited significantly greater hedonic response than the bland foods; ( $t = 16.15$ ,  $p < .001$ ).

#### **Wanting: Predictive Effect of Depression Symptoms on Hedonic Response**

**Chocolate Tasting Lab Task.** Correlation and regression analyses were conducted and revealed that when the Ant-Choc score was predicted, CESD ( $\beta = .110$ ,  $p = .386$ ) was not a significant predictor, after controlling for TEPS-Ant. The overall model fit was adjusted  $R^2 = .071$ , suggesting that 7.1% of the variance in the Ant-Choc score is as a result of the independent variables. Despite the CESD not being predictive of Ant-Choc, the predictive relationship of TEPS-Ant on Ant-Choc was significant, at

(standardized  $\beta = .341, p < .01$ ). See Table 3 for means, SDs and other descriptives of variables, and Table 4 for the correlations related to the lab task<sup>2</sup>.

**Daily Diary.** A two-level model for multilevel analysis was tested, with one Level 1 within-person variable (Diary Day), and two Level 2 between-persons variables (TEPS-Ant, CESD) predicting the outcome (Ant-Tom). The model revealed that there was a significant predictive relationship identified between Ant-Tom and CES-D ( $\beta = -.018, z = -2.263, p < .05$ ) as well as Ant-Tom and TEPS-Ant ( $\beta = .039, z = 4.060, p < .001$ ). See Table 5 for the descriptive of the variables unique to this set of analyses.

### **Predictive Effect of Depression Symptoms on Discrepancy Between Wanting and Liking**

**Lab Task.** Correlation and regression analyses revealed that depression symptoms score ( $\beta = -.022, p = .864$ ) was not a significant predictor, after controlling for TEPS-Ant. The overall model fit was adjusted  $R^2 = .058$ . However, again, the predictive relationship of TEPS-Ant on Discrepancy score was significant, at ( $\beta = -.292, p < .05$ ). See Table 3 for means, SDs and other descriptives of variables, and Table 4 for the correlations related to the lab task.

**Daily Diary.** A two-level model for multilevel analysis was generated, with one Level 1 within-person variable (Diary Day), and two Level 2 between-persons variables

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<sup>2</sup> To rule out any statistically significant results between the CESD and the Ant-Choc or Choc-Disc scores without taking into account the potential contribution of TEPS-Ant, regressions were run and found that there was no predictive effect of CESD on Ant-Choc ( $\beta = .005, p = .966$ ), nor on Choc-Disc ( $\beta = .052, p = .64$ ). Additional analyses were completed to reveal a strong statistical relationship between the TEPS-And and the CESD, TEPS-Ant scores and CESD scores were significantly negatively correlated ( $r = -.406, p < .000$ ), and regression analyses found standardized  $\beta = -.406 (p < .000)$ .

(TEPS-Ant, CESD) predicting the outcome (DD-Disc). Depression symptoms (CESD) was centered on the grand mean, as was trait anhedonia (TEPS-Ant). Neither TEPS-Ant nor CESD was predictive of the amount or direction of difference between the anticipated response score and the experienced response score to everyday events (DD-Disc;  $\beta = -.023, z = -.988$ , and  $\beta = 0.012, z = .626$ , respectively, both ns).

## CHAPTER IV

### DISCUSSION

As has been discussed, anhedonia places a large burden on those struggling with depression, and is related to poorer treatment outcomes and increased risk of suicide. Previous studies looking into the effect of anhedonia within depression have found a reduction in wanting, or anticipated hedonic responses to otherwise pleasurable events (Allen, et al, 1999; Bylsma et al., 2008). Studies have further found that some people with anhedonic depression actually enjoy activities more than they anticipate they will.

#### **Hypothesis 1**

My first hypothesis was that depression symptoms would predict a lower anticipated hedonic response to a task that is largely deemed pleasurable by society – eating chocolate – while accounting for potentially more stable trait anhedonia. I further hypothesized that a similar lower anticipated response would be observed with regard to everyday life events in those with higher depression symptoms. In the chocolate-tasting sensory hedonic response task, no predictive effect of depression symptoms was found on anticipation of eating chocolate. However, there was a strong correlation between trait anhedonia and anticipation of the chocolate tasting task, showing that lower levels of trait anticipatory pleasure predicted lower anticipated tasting pleasure. Within the daily diary

data, however, both depressive symptoms and trait anhedonia predicted a lower anticipatory response to everyday life events.

Many researchers have studied the effect of depression symptoms on the anticipation of pleasant events and found that it is reduced in those with higher depression. However, in direct contrast to previous research, the CESD did not predict a lower anticipated hedonic response score to the sensory hedonic lab task, when taking into account the TEPS-Ant scores, and also when examined on its own. However, the TEPS-Ant did predict the anticipated hedonic response to chocolate, and this finding suggests that there is a relationship trait anhedonia and the anticipation of responses to specific hedonic events. This suggests a relationship between trait anhedonia and the anticipation of hedonic responses that has not been well-studied. The daily diary data showed that some have symptoms of anhedonia and are predicting they will not have a pleasurable hedonic response to future events, and others are predicting they will have greater pleasurable responses to future hedonic events. This suggests that there is a relationship between symptoms of depression and anhedonia on the anticipation of pleasurable life events. One explanation could be that depression affects peoples' hedonic experiences of everyday life events, rather than in an experimental task. Perhaps everyday life events are more likely to be influenced by depression symptoms because they are more complex and more emotion-evoking than stand-alone laboratory tasks. Further, these findings could also mean that the laboratory task is not relatable or generalizable to a predictive relationship of depression and the anticipation of everyday

life events, but still suggest that both tasks were well-suited to predict a reduced hedonic response in those with higher trait anhedonia.

## **Hypothesis 2**

My second hypothesis suggested that those with higher depression scores would actually enjoy their hedonic experiences in the lab and in everyday events more than they anticipated, thus showing a greater discrepancy between their wanting and liking scores. In contrast with the aforementioned previous research (Clark, 1984; Sherdell, 2012; Shankman et al. 2014; Starr & Hershenberg, 2017), this hypothesis was not supported by either the lab task or the daily diary data, though greater trait anhedonia predicted a greater discrepancy between the anticipation and enjoyment of the chocolate task. Additionally, this relationship was in the direction that was predicted – not only did those with higher trait anhedonia anticipate enjoying eating chocolate less, but they actually enjoyed the chocolate tasting task more than they thought they would. Interestingly, while not statistically significant, the directionality of the results in the daily diary findings also supported these findings.

**Controlling for Trait Anhedonia.** Given that Leventhal (2014) found that the CESD was weakly correlated with the TEPS-Ant subscale (correlation coefficient of 0.14), it appeared as though the CESD would provide a measure of depression potentially less influenced by trait anhedonia. By using the TEPS-Ant to control for trait anhedonia, we could theoretically separate depression (CESD score) from any trait anhedonia that might be present and captured by the measure in order to single-out state-dependent

anhedonia scores (hedonic response scores). In contrast to expectations, the CESD and the TEPS-Ant were significantly and moderately correlated. The fact that there was no relationship found between depression symptom scores and the dependent variable, in 3 of the 4 analyses, and there were actually statistically significant results of the TEPS-Ant scores predicting hedonic response scores in 3 of the 4 analyses suggests that the anticipation of hedonic responses is more connected with trait anhedonia than with depression scores.

### **Limitations of the Study**

One potential limitation of this study is the fact that a clinical sample was not used for this study, and therefore may not have the range of depression scores as we might have if we had drawn from a clinical population. However, one recent study by Acharya, Jin & Collins found a mean score of 16.24 (SD = 10.63) on the CESD in their sample of 631 undergraduates (2018), while this study had a mean CESD score of 17.70 (SD = 12.37).

Though we know that the chocolate tasting task was successful at inducing a hedonic response, as compared with the bland foods, it is also possible that the sensory experience chosen for the lab task (chocolate-tasting) is not the one to evoke the most emotional response with regard to anticipated or experienced pleasure. This could mean that people with higher depression symptoms do not anticipate sensory hedonic experiences less than those with fewer depression symptoms – in other words, people with depression might still anticipate enjoying a sensory experience like chocolate

similarly to those who are well. However, the results of this study do suggest that those with higher trait anhedonia anticipate enjoying a sensory hedonic experience like chocolate less than their non-trait anhedonic counterparts. This could be because the experience of eating chocolate is not personally meaningful enough to evoke stronger emotional responses or be affected by emotion states. It is therefore possible that different hedonic response stimuli, such as film clips or images, could present more complex, emotional experiences and could result in anticipated and experienced hedonic response scores affected by an emotion state like depression.

While it is possible that I did not use an emotionally-relevant lab experience, as proposed above, it is also possible that the measure of anticipatory hedonic response to the chocolate-tasting lab task was not sensitive enough to pick up a hedonic response from participants. Given that the anticipatory sensory hedonic response score results from only a single question it is potentially limited – it is possible that a more comprehensive assessment of hedonic response to the sensory task could yield a more accurate measure of anticipation of hedonic response that could then be analyzed statistically with an emotion state, such as depression.

The sample was well-distributed for race/ethnicity, however it was not well-balanced for gender. While the study sample who participated in the UNCG Psychology Department Mass Screening during the 2018-2019 academic year was made up of 77% female participants ( $N = 769$ , Mass Screening total  $N = 996$ ), this sample consisted of 86.6% female participants. Not only is this sample not the most representative of the

greater population, but it is possible that gender effects could be evaluated were there a more representative split of participant genders. While gender differences have been noted in social anhedonia among those diagnosed with or at greater risk of developing schizophrenia-related disorders, potential gender differences have not been well-examined in people with anhedonia and depression

### **Strengths**

The primary strength of this study was the combination of different research methodologies which provided the opportunity to measure anticipatory and consummatory hedonic responses using both an experimental task and daily diary data capturing everyday real-life experiences. Additionally, the daily diary hedonic response questionnaires capture hedonic responses to both social and physical experiences, thus capturing a more representative sample of everyday hedonic experiences. This methodological approach made it possible to test my two different hypotheses – 1) assessing whether depressive symptoms predicted anticipation of hedonic responses, and 2) whether depressive symptoms predicted a discrepancy between the anticipation of and actual experience of hedonic responses – in two separate ways – a) a controlled laboratory task, and b) a daily diary capture of everyday hedonic experiences.

With regard to the daily diary surveys, participants were only asked to complete seven days, and were short enough to answer quickly, so the time commitment was one which kept most people engaged throughout the week. Additionally, the diary surveys were composed in such a way so as to maximize their memory of the day before they

answered the relevant questions regarding their hedonic response to events, but also included distractors that took their mind off of the current day before asking them to predict their hedonic responses to events for the next day.

### **Conclusions and Future Directions**

While the primary hypotheses were not fully supported, the study design provided the opportunity to gather rich information which in turn made it possible to analyze and compare experimental data and daily diary data. Though it is not a complete surprise that lower TEPS-Ant scores predicted lower anticipated hedonic response scores, both in the lab task and in everyday life events, it also predicted a greater discrepancy between anticipated and experienced hedonic response to the lab task. Given that there is still much that is unknown about the presence, and perhaps interaction of, trait and state anhedonia in depression, it lends itself to further examination, particularly to study exactly what the trait anhedonia scale measures in the context of a laboratory-based sensory hedonic response task and in daily life. For example, do people with greater trait anhedonia have lower anticipated hedonic responses to different types of laboratory stimuli, such as film clips and images? Are people with greater trait anhedonia affected in both the physical and social domains? Additionally, given that not much research has been done on trait anhedonia in depression, and how that affects everyday life events, it is necessary to explore this further. For instance, are there other personality traits associated with trait anhedonia that put some people at greater risk of being affected by mood

disorders? Are people with higher levels of trait anhedonia at greater risk for mood disorders than people who have higher (or more variable) levels anhedonia?

Unlike the lab task, depression symptoms were found to predict reduced anticipated hedonic response in everyday life events, even when taking into account trait anhedonia using the TEPS-Ant. It is possible that this daily diary finding exemplifies one of the limitations of lab tasks -- perhaps anhedonic experiences related to depressive symptoms cannot be as easily measured in a sensory lab task as it is to assess with regard to a person's everyday activities. There could be many explanations for this, for instance, perhaps the novelty of interacting with research staff induces more normalized behaviors or cognitions related to depression symptoms or hedonic responses. This could be because participants may feel they are under scrutiny and wish to appear as 'normal' as possible.

Despite the fact that three of the four hypotheses weren't statistically supported in the sample at its current size, it is interesting to note and to speculate on what the findings did show, especially regarding the kinds of trends that were seen. For example, the TEPS-Ant appears to be a consistent predictor of reduced anticipation of hedonic responses to pleasant events, as well as predicting greater discrepancies between anticipated and experience hedonic responses. Those with decreased TEPS-Ant scores (i.e. increased anhedonic features) ultimately experienced greater positive hedonic responses than people they had predicted they would experience

The combination of a lab task paired with a daily diary study (or some other type of real-life measurement) ought to become more common in psychological research. Not only would this allow researchers to test their hypotheses using two types of methodology, it could also allow researchers to examine results obtained from a lab task directly with daily diary data collected experiences from everyday life. Given that we know so little about how laboratory tasks relate to the daily lived experiences of people with anhedonia, this model could provide a wealth of information to researchers in many fields of psychological research.

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APPENDIX A

TABLES

Table 1

Measures for Hypothesis 1 in the Sensory Hedonic Response Lab Task and Daily Diary

Construct being measured	Sensory Lab Task	Daily Diary	Descriptions of score output
Anticipation	'Ant-Choc' Chocolate anticipation	'DD-Ant' Diary Hed Exper Tom (1, 2, 3, 4, 5, 6, 7)	Higher score = greater anticipated pleasure
Trait Anhedonia	(Pre-lab) TEPS-Ant	(Pre-lab) TEPS-Ant	Lower score = greater anhedonia
Depression symptoms	(Pre-lab) CESD	(Pre-lab) CESD	Higher score = greater depression symptoms

*Note:* Ant = anticipated, Choc = chocolate, Hed = hedonic, Exper = experience, Tom = tomorrow, Ant-Choc = hedonic response score for anticipating eating chocolate, DD = daily diary, DD-Ant = daily diary hedonic response score for anticipating tomorrow's events, TEPS-Ant = anticipatory subscale of the Temporal Experiences of Pleasure Scale, CESD = Center for Epidemiologic Studies Depression Scale

Table 2

## Measures for Hypothesis 2 in the Sensory Hedonic Response Lab Task and Daily Diary

Construct being measured	Sensory Lab Task	Daily Diary	Descriptions of score output
Anticipation	'Ant-Choc' Chocolate Anticipation	'DD-Ant' Diary Hed Exper Tom (1, 2, 3, 4, 5, 6, 7)	Higher score = greater anticipated pleasure
Consumption	'HighestTotal' Experienced Chocolate	'DD-Exp' Diary Hed Exper Tod (2, 3, 4, 5, 6, 7)	Higher score = greater experienced pleasure
Discrepancy	'Disc-Choc' Difference between pre-lab ('Ant-Choc') and lab (('HighestTotal') scores	'DD-Disc' Difference between experienced hedonic (('DD-Exp')) responses and anticipated responses ('DD-Ant')	Higher score = greater difference between ant and exp pleasure ('+' = more pleasure than expected)
Trait Anhedonia	(Pre-lab) TEPS-Ant	(Pre-lab) TEPS-Ant	Lower score = greater anhedonia
Depression symptoms	(Pre-lab) CESD	(Pre-lab) CESD	Higher score = greater depression symptoms

*Note:* Ant = anticipated, Choc = chocolate, Hed = hedonic, Exper = experience, Exp = experienced, Ant-Choc = hedonic response score for anticipating eating chocolate, DD = daily diary, DD-Ant = daily diary hedonic response score for anticipating tomorrow's events, DD-Exp = daily diary hedonic response score for today's experienced events, Disc-Choc = difference between anticipated and experienced hedonic response to chocolate in the sensory hedonic response task, DD-Disc = difference between daily diary anticipated and experienced hedonic response scores to everyday events, TEPS-Ant = anticipatory subscale of the Temporal Experiences of Pleasure Scale, CESD = Center for Epidemiologic Studies Depression Scale

Table 3

## Descriptives for Pre-Lab Questionnaires and Anticipated and Experienced Hedonic Response Scores

	<i>n</i>	Mean	SD	Skewness	Kurtosis
TEPS-Ant	85	45.91	8.54	-.50	-.26
TEPS-Cons	85	36.02	6.62	.25	-1.01
mMASQ-AD	87	23.08	7.40	-.02	-.65
CESD	90	17.54	12.16	.93	.10
Ant-Choc	97	5.59	2.32	-.84	-.12
Exp-Choc	97	6.96	1.44	-2.04	4.50
Choc-Disc	97	1.37	1.99	.38	.09
DD-Ant	517	3.73	.85	-.50	-.20
DD-Exp	519	3.57	.93	-.57	-.18
DD-Disc	401	-.18	.80	-.92	3.92

*Note:* *n* = number of samples included in the analysis, SD = standard deviation, TEPS-Ant = anticipatory subscale of the Temporal Experiences of Pleasure Scale, TEPS-Cons = consummatory subscale of the Temporal Experiences of Pleasure Scale, mMASQ-AD = anhedonic depression subscale of the mini-Mood and Anxiety Symptom Questionnaire, CESD = Center for Epidemiologic Studies Depression Scale, Ant-Choc = hedonic response score for anticipating eating chocolate, Exp-Choc = hedonic response score for experience of eating chocolate, Disc-Choc = difference between anticipated and experienced hedonic response to chocolate in the sensory hedonic response task, DD-Ant = daily diary hedonic response score for anticipating tomorrow's events, DD-Exp = daily diary hedonic response score for today's experienced events, DD-Disc = difference between daily diary anticipated and experienced hedonic response scores to everyday events.

Table 4

## Correlations Between Pre-Lab Questionnaires and Anticipated and Experienced Hedonic Response Scores

	TEPS- Ant	TEPS- Con	mMAS Q-AD	CESD	Ant- Choc	Exp- Choc	Disc- Choc	DD-Ant	DD-Exp
TEPS-Ant									
TEPS_Cons	<b>.502**</b>								
mMASQ- AD	<b>-.472**</b>	<b>-.298**</b>							
CESD	<b>-.406**</b>	-.172	<b>.654**</b>						
Ant-Choc	<b>.255*</b>	.167	-.016	.023					
Exp_Choc	.134	<b>.320**</b>	-.041	.069	<b>.521**</b>				
Disc-Choc	-.196	.042	-.013	.023	<b>-.788**</b>	.115			
DD-Ant	.411	.331	-.377	-.331	.209	.198			
DD-Exp	.301	.270	-.307	-.234	.223	.190	<b>.618**</b>		
DD-Disc	-.080	-.021	.050	.095	.024	.006	-.004	<b>.530**</b>	

*Note:* TEPS-Ant = anticipatory subscale of the Temporal Experiences of Pleasure Scale, TEPS-Cons = consummatory subscale of the Temporal Experiences of Pleasure Scale, mMASQ-AD = anhedonic depression subscale of the mini-Mood and Anxiety Symptom Questionnaire, CESD = Center for Epidemiologic Studies Depression Scale, Ant-Choc = hedonic response score for anticipating eating chocolate, Exp-Choc = hedonic response score for experience of eating chocolate, Disc-Choc = difference between anticipated and experienced hedonic response to chocolate in the sensory hedonic response task, DD-Ant = daily diary hedonic response score for anticipating tomorrow's events, DD-Exp = daily diary hedonic response score for today's experienced events, DD-Disc = difference between daily diary anticipated and experienced hedonic response scores to everyday events.

\*  $p < 0.05$ , two-tailed.

\*\*  $p < 0.01$ , two-tailed.

Table 5

Descriptives for Daily Diary Variables

	<i>n</i>	Mean	ICC
DD-Ant	517	3.73	.65
DD-Exp	519	3.57	.55
DD-Disc	401	-.18	.25

*Note:* *n* = number of samples included in the analysis, SD = standard deviation, ICC = interclass coefficient, DD-Ant = daily diary hedonic response score for anticipating tomorrow's events, DD-Exp = daily diary hedonic response score for today's experienced events, DD-Disc = difference between daily diary anticipated and experienced hedonic response scores to everyday events.

## APPENDIX B

### MEASURES AND MATERIALS

Mini Mood and Anxiety Symptom Questionnaire (Mini-MASQ; sample)  
(Casillas & Clark, 2002)

Instructions: Below is a list of feelings, sensations, problems and experiences that people sometimes have. Read each item and then fill in the blank with the number that best describes how much you have felt or experienced things this way during the past week, including today.

1	2	3	4	5
Not at all	A little bit	Moderately	Quite a bit	Extremely

\_\_\_ 1. Felt really happy

\_\_\_ 2. Felt tense of “high strung”



Center for Epidemiologic Studies Depression Scale (CES-D), NIMH  
(Lewinsohn, Seeley, Roberts, & Allen, 1997)

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

	Rarely or none of the time (less than 1 day )	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
1. I was bothered by things that usually don't bother me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I did not feel like eating; my appetite was poor.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I felt that I could not shake off the blues even with help from my family or friends.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I felt I was just as good as other people.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I had trouble keeping my mind on what I was doing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I felt depressed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I felt that everything I did was an effort.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I felt hopeful about the future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I thought my life had been a failure.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I felt fearful.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. My sleep was restless.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I was happy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I talked less than usual.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. I felt lonely.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. People were unfriendly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. I enjoyed life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. I had crying spells.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. I felt sad.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. I felt that people dislike me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. I could not get "going."	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**SCORING:** zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items is reversed. Possible range of scores is zero to 60, with the higher scores indicating the presence of more symptomatology.

Snaith-Hamilton Pleasure Scale (SHAPS; sample)  
(Snaith et al., 1995)

This questionnaire is designed to measure your ability to experience pleasure in the last few days. Read each statement carefully and select the option that indicates how much you agree or disagree with each statement.

1. I would enjoy my favorite television or radio program.  
Strongly disagree \_\_\_  
Disagree \_\_\_  
Agree \_\_\_  
Strongly Agree \_\_\_

## Anticipated Hedonic Response Scale

How much you would feel

- a) \*pleasure,
- b) boredom, and
- c) satisfaction

during the following activities (0=“not at all”; 8=“extremely”):

- working on solving a puzzle
- eating chocolate\*
- listening to your favorite type of music
- watching a movie
- drinking coffee
- filling out paperwork

\*Rating used to calculate the anticipated hedonic response to the lab task.

### Experienced Hedonic Response Scale

Please rate the following statements are true (0 = “not at all”; 8 = “extremely”):

- the food tasted good
- the food was bitter
- I would eat more
- the food was bland
- the food was sweet
- I didn't like the food
- the food was sour
- I enjoyed tasting this food

Hedonic experiences of daily events – TODAY (Experienced)

Please enter how much you agree with the following things that happened TODAY:

1. I found pleasure in a hobby or pastime.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
2. I enjoyed being productive/helpful/masterful at work/school.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
3. I enjoyed reading something or watching tv.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
4. I found pleasure in receiving praise from others.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
5. I enjoyed being or talking with family or close friend(s).
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
6. I enjoyed something I ate a lot.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
7. I enjoyed a cup of tea or coffee or my favorite drink.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
8. I enjoyed being or talking with my coworkers/classmates.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
9. I found pleasure in small things, e.g. bright sunny day, the smell of a flower, beautiful view, someone smiling.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A

Hedonic experiences of daily events – TOMORROW (Anticipated)

Please enter how you anticipate you will feel TOMORROW about the following things:

1. I will find pleasure in a hobby or pastime.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
2. I will enjoy being productive/helpful/masterful at work/school.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
3. I will enjoy reading something or watching tv.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
4. I will find pleasure in receiving praise from others.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
5. I will enjoy being or talking with family or close friend(s).
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
6. I will enjoy something I ate a lot.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
7. I will enjoy a cup of tea or coffee or my favorite drink:
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
8. I will enjoy being or talking with my coworkers/classmates.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A
9. I will find pleasure in small things, e.g. bright sunny day, the smell of a flower, beautiful view, someone smiling.
  - a. Rating of 1 (not at all) to 5 (extremely)
  - b. N/A