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Effects of Mental Health Disorders on Time Perception

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EFFECTS OF MENTAL HEALTH DISORDERS ON TIME PERCEPTION

by

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ABSTRACT

Research suggests a relationship between time distortion and mental health disorders, and the present study sought to examine this proposition. Prior research suggests that negative emotions are associated with the slowing down of time. Because mental health disorder symptomology is associated with more negative emotions, it was predicted that negative emotions would mediate the relationship between mental health disorder symptomology and time distortion. A survey was administered to university students that contained measures of anxiety, depression, emotional experiences, and time perception. Mental health disorder symptomology was found to be related to negative emotions. However, negative emotions and mental health disorder symptomology were not related to time distortion. Thus, the proposed mediation model was not supported. The primary reason for these results likely lies in the challenges of measuring time distortion. Despite the lack of effects found in the present study, investigating this topic is crucial for understanding the perceptual experiences of those with mental health disorders.

Keywords: Mental health disorders, time distortion, time perception

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EFFECTS OF MENTAL HEALTH DISORDERS ON TIME PERCEPTION

Perceptual distortions of time are far from being unheard of in our everyday occurrences (Blom et al., 2021). This notion is exemplified by the existence of common idioms in the English language, such as "time flies when you are having fun" or "time drags when you are bored." While everyday occurrences may impact the perception of time, other factors also play a considerable influence. Recent theoretical developments have revealed that specific events or situations, such as mental health disorders, might affect one's perception of time (Wyrick, 1977). According to the National Institutes of Health (2020), nearly one in every five adults in the United States has a mental illness. Individuals with mental health disorders, such as depression and anxiety, have reported feeling a slowing of the passage of time, meaning these individuals have experienced an altered perception of time (Gil & Droit-Volet, 2009). Other factors, such as psychiatric medications, age, and emotions, have also been seen to influence the effect on time perception.

Time perception is a concept that Gustav Theodor Fechner first introduced in the field of psychophysics during the late 19th century. Fechner suggests that individuals do not perceive actual time but rather its passage, or as he refers to it — "events in time" (Carman, 2021). This has led to many researchers questioning whether time passes as one looks forward to a specific event or if it passes while one is in the moment (Carman, 2021). The American Psychological Association (2022) refers to it as a perceptual transformation during which individuals seem to perceive time as passing very quickly or very slowly. The concept of time and how others perceive it is a topic that is still under investigation today (Blom et al., 2021; Gil & Droit-Volet, 2009; Thönes & Oberfeld, 2015).

Past research on time distortion suggests that attention plays a huge factor in time perception (Carman, 2021). The amount of attention an individual dedicates to a task can cause

them to feel like time went by quickly or dragged on (Carman, 2021). Similarly, Gable and Poole (2012) propose that when individuals feel highly motivated, they feel as if time passes more quickly. A key element Gable and Poole use is positive approach motivation. As they explain, states relating to appetitive acquisition should be associated with a speed-up of time as it narrows the memory and attention processes, allowing individuals to shut out irrelevant thoughts and feelings (Gable & Poole, 2012). The more attention an individual spends on a task, the quicker it passes by (Gable & Poole, 2012).

Other research proposes that emotions influence how individuals perceive time. For instance, Dawson and Sleek (2018) suggest that when people feel happy or are in awe, they sense that time passes faster. In contrast, those who experience more boring or worrisome experiences perceive that time passes slower (Dawson & Sleek, 2018). In a study conducted by Eagleman (2018), participants wore a chronometric device on their wrists while riding a 15-story drop park ride. When asked how long they perceived the fall to last, most overestimated the duration of the fall, suggesting that negative emotions, such as fear, can impact time perception and portray it as going slower (Eagleman, 2018).

While there is a lack of research conducted on how the effects of mental health disorders affect time distortion, past research suggests that individuals with mental health disorders, such as depression and anxiety, experience a slower passage of time (Droit-Volet, 2013). With that in mind, this study's main goal is to further explore the relationship between mental health disorders and time perception. The influence of other factors (e.g., emotions, psychiatric medications, and age) on the distortion of time will also be discussed. The following section in this paper will go further in-depth into the relevant findings regarding this topic, including information on pertinent theories and past research. Next, the goals and hypotheses of this thesis will be identified. The last

section will provide more details on the method, incorporating details about the participants, materials, and procedures.

LITERATURE REVIEW

This section discusses relevant theories, definitions, and past research to develop a more thorough understanding of how mental health disorders can influence time perception. The literature review begins with an explanation of mental health disorders, including a description of depression and anxiety. The review then moves on to pertinent theories of time perception, including an overview of the Scalar Expectancy Theory (Gibbon, 1977), the Attentional-Gate Model (Zakay & Block, 1995), and the Striatal Beat Frequency Model (Matell & Meck, 2000). These theories provide a background on how time is measured, the applications of the models, and how individuals perceive time as a whole. Lastly, the goals and hypotheses of the present study are discussed.

Mental Health Disorders

Mental health disorders are conditions that can affect one's behavior, mood, and thinking (Mayo Clinic, 2019). These include depression, anxiety disorders, eating disorders, and personality disorders. These disorders tend to affect an individual's social life, school or work life, as well as personal relationships. According to the Mayo Foundation for Medical Education and Research (2019), some of the common mental health disorder symptoms include feeling down, extreme mood changes, increased fears or worries, withdrawal from social activities, changes in eating habits, inability to cope with daily problems, detachment from reality, and suicidal thoughts. Though the exact cause of most mental health disorders remains relatively unknown, research suggests that heredity, psychological trauma, and environmental stress play a role in the development of these disorders (Bhandari, 2020). Additionally, according to the National Institute of Mental Health (2022), mental illnesses are prevalent, especially in the United States. One in every five adults suffers from a mental illness. These illnesses can range from mild, moderate, and

severe, depending on the condition and degree of severity. Because depression and anxiety are among the most common mental health disorders (World Health Organization, 2022), they will be the focus of the present study.

Depression

Depression is one of the most common psychological disorders affecting over 121 million people worldwide (Reddy, 2010). According to the Mayo Foundation for Medical Education and Research (2018), depression affects how an individual feels, thinks, and behaves. These individuals may have trouble completing day-to-day tasks (i.e., sleeping, working, cooking) and sometimes may even contemplate death. Depressive symptoms include feelings of sadness, angry outbursts, frustration, sleep disturbances, trouble thinking, and more (Mayo Clinic, 2018). Depression is a disorder that may require long-term treatment as it cannot be cured in a day. Medications and psychotherapy are among the most effective ways to treat depression (Mayo Clinic, 2018). Some medications include selective serotonin reuptake inhibitors (SSRIs), serotonin-norepinephrine reuptake inhibitors (SNRIs), and tricyclic antidepressants (TCAs). Psychotherapy is a form of treatment that involves talking about the disorder with a mental health professional. During these sessions, the individual can gain a greater understanding of their mood, feelings, behaviors, and thoughts (Mayo Clinic, 2018).

Anxiety

Anxiety disorders are known to be the most pervasive class of mental illnesses. Every year, about 18% of the population is diagnosed with an anxiety disorder (Stein & Stein, 2008). Some anxiety disorder symptoms include feeling nervous, hyperventilation, sweating, and feeling weak, among others. Patients with anxiety disorders frequently have excessive and persistent fears and worries about day-to-day situations (Mayo Clinic, 2018). They are also known to experience panic

attacks more often than others. Panic attacks are episodes of intense anxiety and terror that reach a peak within a couple of minutes (Mayo Clinic, 2018). They tend to occur due to long periods of stress, over breathing, and even activities that lead to intense physical reactions (i.e., exercise). These attacks cause individuals to feel like their heart is pounding and they cannot breathe, as if they are going to die or go crazy. Panic attacks can occur out of nowhere without any warning or any specific trigger. Like depression, psychotherapy and medications are the best and most effective ways to treat anxiety disorders. Psychotherapy will allow individuals to express their worries and concerns and, with time, overcome them. Medications, such as monoamine oxidase inhibitors (MAOIs) and non-competitive N-methyl-D-aspartate receptor antagonists (NMDA), can also help treat anxiety disorders as they help relieve some symptoms (Mayo Clinic, 2018).

Time Perception and Distortion

Time perception is a field of study within neuroscience and psychology. It refers to the sense of time; however, it differs from the other senses as time cannot be directly perceived. As aforementioned, time perception is known as the passage of time, that is, whether it speeds up or slows down time (Carman, 2021). According to the American Psychological Association (2022), time distortion is a type of perceptual transformation that can be experienced in altered states of consciousness, where time seems to pass with great rapidity or extreme slowness. Similarly, time distortion can be described as the time one is out of tune with their overall experience (Blom et al., 2021). Blom and colleagues (2021) distinguished five different types of time distortion—the most common category being the slow-down and speed-up phenomena. Statistics show that 39% of all time distortions were unimodal in nature, meaning that only the phenomenological experience of time passing is affected (Blom et al., 2021). The other 61% includes visual, kinaesthetic, and auditory modalities. Moreover, the research suggests that 40% of the time distortions described

were bimodal in nature, 19% trimodal, and 1% involved four modalities (Blom et al., 2021). Bimodal and trimodal refer to the number of modalities involved during time distortion. Thus, time perception is fundamentally linked to sensory modalities (e.g., vision, audition, touch). This is because sensory perception becomes affected when one's perception of time goes awry (Blom et al., 2021). While time distortions have been associated with substance use, they also occur in patients with various conditions, such as strokes, head trauma, mood disorders, migraines, and schizophrenia (Blom et al., 2021). Additionally, time distortion can take different forms apart from the slow-down or speed-up of time. Time can be experienced backward, being fragmented, moving in circles, or even repeating itself (Blom et al., 2021).

Alice in Wonderland Syndrome

The Alice in Wonderland Syndrome (AIWS) is a disorder distinguished by distortions of the body's spatial properties and visual perceptions (Blom, 2016). According to Matria et al. (2016), individuals experience visual and/or auditory perceptual distortions, which have been seen to also influence the passage of time. The name of the disorder refers to the famous children's book Alice's Adventures in Wonderland by Lewis Carroll (Carroll, 1865). In the book, Alice experiences her body growing both bigger and smaller. The term Alice in Wonderland Syndrome began to be scientifically studied when English psychiatrist John Todd began doing some investigation (Blom, 2016). Although time distortion can be associated with numerous conditions, such as mood disorders, an individual who describes time distortion can also be diagnosed with AIWS, as it is considered the umbrella term for time distortion (Blom et al., 2021). Blom et al. (2021) determined that children with AIWS admitted to time moving quicker, whereas adults with AIWS perceived time as moving slower. In this case, age seemed to influence the perception of time among individuals.

Measuring Time Distortion

Measuring time distortion is very challenging, as there is no specific device that measures the subjective experience of the speed-up or slow-down of time. However, researchers have devised various psychometric tools and techniques to attempt to measure time distortion. The internal-clock model has become a very popular tool that is able to interpret the passage of time. In this model, a series of pulses are produced by an internal pacemaker (Livesey, Wall, & Smith, 2007). The pulses are collated, counted, and then compared to create time estimations. The most popular model is Scalar Expectancy Theory (Droit-Volet, 2013). In this model, time estimates depend on the number of pulses accumulated during the interval. Similar to this theory is the Striatal Beat Frequency model, which is currently considered to be the most credible of the internal clock. In this model, a cortico-striatal circuit underlies the processing time (Droit-Volet, 2013). This model presents some issues, as some researchers have differing views on the specific time-processing mechanism and claim that measuring time comes from a group of neurons that occur from the dynamic activity, which can then code time. (Droit-Volet, 2013).

Theories of Time Distortion

Scalar Expectancy Theory

The Scalar Expectancy Theory (SET), also known as the scalar-timing model, accounts for the duration of time perception. It is an intricate theory designed to help understand time perception. Initially proposed by John Gibbon, the SET model divides the mind's temporal processing system into three parts: the clock, memory, and decision stages (Gibbon, 1977). The perceptual timing mechanism known as the internal clock includes the pacemaker, the switch, and the accumulator (Gibbon, 1977). The pacemaker is a device that emits pulses to the accumulator, and the accumulator is the recorder of the pulses. In the first stage of temporal processing, the

switch opens during the beginning of an external signal and permits pacemaker pulses to be collected into the accumulator, similar to a stopwatch (Zakay & Block, 1995). During the second stage, the accumulator transfers the number of pulses to working memory. The number of pulses stored in the working memory is then compared with the reference intervals stored in the reference memory. Reference memory contains a long-term memory representation of an estimated number of pulses accumulated from the past (Zakay & Block, 1995). During the decision stage, the number of pulses from the working memory and the counted pulses from the reference memory will be the source of scalar variability (Zakay & Block, 1995). For example, in a tennis ball machine, there is a visual signal (i.e., flashing light) or an external auditory signal (i.e., alarm). These signals are presented before the tennis ball is released from the tennis ball machine. As the tennis ball is released, the pulses are temporarily recorded in the store, and when the following ball is released, the comparator references the preceding number of pulses within the store to conclude the proper time to hit the released tennis ball with the racquet.

Individual and pathophysiologists' differences arise in timing and time perception due to alterations in the function of the model's attention, clock, memory, or decision stages (Allman & Meck, 2011). As a result, other models (i.e., the Attentional-Gate Model and Treisman's Internal Clock Model) have been developed to attempt to simulate the aspect of human performance on interval-timing tasks following the foundation of the Scalar Expectancy Theory (Allman & Meck, 2011).

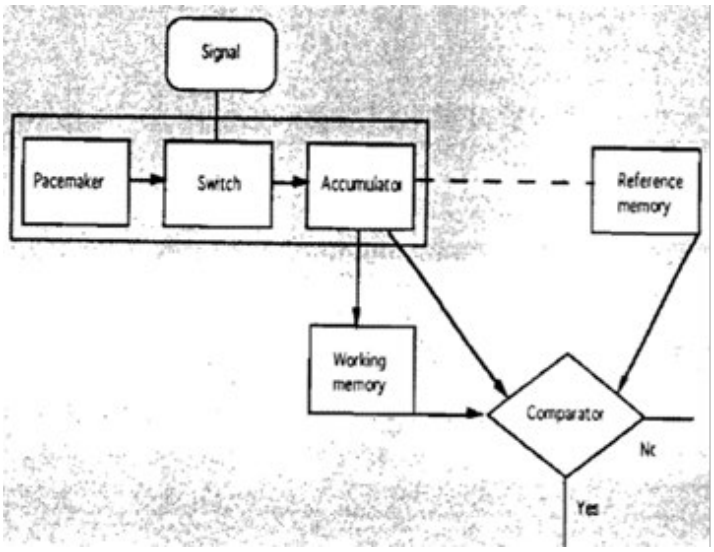


Figure 1: The Scalar Expectancy Theory Model (Gibbon, 1977)

The SET model has been used to explain differences in time perception of individuals with mental and cognitive disorders. In one study, patients with disorders such as Parkinson's Disease and Schizophrenia were seen to disrupt the temporal dynamics leading to a slowing down of processes involving time and time perception (Allman & Meck, 2011). This was thought to be because of the depletion of dopaminergic function, which impacts cognitive functions like attention and memory (Allman & Meck, 2011). And as previously discussed, attention and memory have been hypothesized to impact time perception. Dopaminergic functions are neurotransmitters that serve as treatment for psychiatric disorders like Parkinson's Disease (Allman & Meck, 2011). The findings suggest that mesocortical dopamine pathways degenerate in Parkinson's Disease, contributing to temporal processing distortions (Allman & Meck, 2011). Furthermore, the observation where depressed individuals reported that they perceived time going slower can be explained by the SET model (Mioni et al., 2016). The variation at the level of the pacemaker and the internal clock is hypothesized to run faster than the non-depressed individuals (Mioni et al., 2016). The perceived length of an interval will be longer the more pulses are

accumulated. In other words, if the individual's clock runs faster, and more pulses get accumulated within an interval, the interval will be perceived as longer compared to an individual with a slower clock speed.

The Attentional-Gate Model

The Attentional-Gate Model (AGM) is very similar to the Scalar Expectancy Theory as it still has the same components of the SET: the pacemaker, the switch, and the accumulator. The most significant difference is the addition of a cognitive temporal tool known as the attentional gate. This gate is a mechanism that is controlled by the allocation of attention to time (Zakay & Block, 1995). The more attention is allocated to time, the wider the gate opens, and more pulses are emitted by the pacemaker, which can pass through and be transferred to the counter (Zakay & Block, 1995). However, when time is not relevant, and the attentional components are not focused on time, the gate closes, and no pulses are received at the counter (Zakay & Block, 1995). Consequently, time is the major component in increasing the level of activity of the gate.

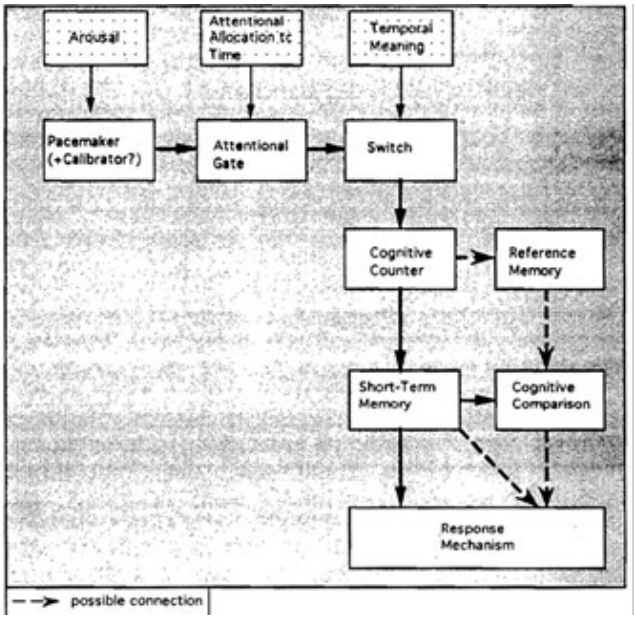


Figure 2: The Attentional Gate Model (Zakay & Block, 1995)

Temporal information processing refers to perceiving temporal properties of an experience, which allows the observer to approximate the duration of the time passed (Nittrouer, 1999). Time distortion occurs when more attention is given to non-temporal information processing and less attentional resources are distributed to temporal processing. The AGM model has also been used to explain time distortion in anxious individuals. Threatening stimuli increase arousal, which according to AGM, should lead to duration overestimation, meaning the speeding up of time (Bar-Haim et al., 2010). However, past research has shown that anxious individuals allocate more attention to threat-related stimuli rather than neutral stimuli. In turn, anxious individuals report experiencing time moving slower than non-anxious individuals. (Bar-Haim et al., 2010). In another study conducted by Bar-Haim et al. (2010), emotions also seemed to have a big effect on anxious and non-anxious individuals when exposed to fearful and calm faces. Results indicated that anxious individuals experienced time to move more slowly when presented with threat stimuli SUCH AS (Bar-Haim et al., 2010).

Striatal Beat Frequency Model

The Striatal Beat Frequency Model (SBF) is a neurobiological model that produces an accurate and constant interval timing (Allman & Meck, 2012). The SBF model neurobiologically instantiates and embodies the Scalar Expectancy Theory Model (Gibbon, 1977). The striatum is a part of the basal ganglia, which refers to the matter in the brain that controls movement and balance contingent on detecting of oscillatory processes (Allman & Meck, 2012). Oscillatory is the process of moving back and forth constantly, similar to a pendulum. Thus, the SBF model supposes that during the beginning of a timed signal, populations of thalamic and cortical neurons reset their phase and synchronize, allowing for oscillation at their endogenous periodicities (this stage mimics the clock stage from the Scalar Expectancy Theory) (Allman & Meck, 2012). Dopamine release is

at the onset of the signal, which plays a part in the resetting function of cortical neurons, acting as a start gun. The adjustment of corticostriatal synaptic weights allows the striatal neurons to discriminate and become 'tuned' to certain patterns of coincident oscillatory activity (similar to the memory stage in the Scalar Expectancy Theory) (Allman & Meck, 2012). Time intervals can be represented by the cortical oscillatory patterns, which are initiated by the continuous repetition of oscillatory activation, causing a function of time changing (Cheng et al., 2016).. The striatal neurons are able to detect these patterns, very similar to musical cords, and function similarly to the decision stage in the Scalar Expectancy Theory (Allman & Meck, 2012). Striatal output travels to the thalamus through two pathways, the direct and indirect, which loops back to the striatum and cortex. This influences the oscillatory activity rate, which permits clock speed alterations by changing the input to striatal neurons (Allman & Meck, 2012).

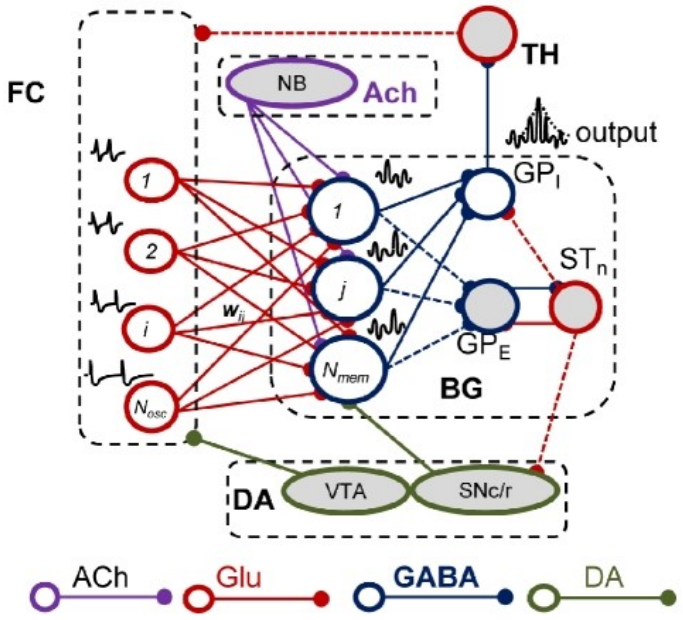


Figure 3: The Striatal Beat Frequency Model (Matell & Meck, 2000)

As mentioned earlier, the striatum is part of the basal ganglia, which is in control of the ability to control the speed of movement (Yin, 2014). The basal ganglia are group of subcortical

nuclei that allow for motor control and voluntary movements. Mental health disorders, such as Parkinson's disease, include symptoms like bradykinesia, meaning the slowness of movement (Yin, 2014). Conversely, in other disorders, such as Tourette syndrome, patients experience rapid tics. Thus, recent research conducted has implicated dopamine and the basal ganglia in action timing (Yin, 2014). The deficit of action timing in disorders like Parkinson's disease and Tourette syndrome causes patients to experience a slowdown or a speed-up in time (Yin, 2014). During Parkinson's disease, the dopamine neurons die, which results in reduced dopamine in the basal ganglia, and patients may experience symptoms like bradykinesia (Terao et al., 2021). With speculation that bradykinesia may be involved with the temporal processing of the mind, Terao and colleagues (2021) concluded that the internal clock ticks at a slower pace when dopamine depletion is present.

Mental Health Disorders and Time Distortion

Though past research has examined the relationship between emotions, cognition, and time distortion, little work has been done on the relationship between mental health disorders and time perception. This gap in the literature may stem from the difficulty of defining and measuring time distortion. Nevertheless, the research that does exist on this topic suggests that individuals who experience symptoms associated with mental disorders (e.g., feeling sad, excessive fear or worry, and detachment from reality) perceive time as passing by slower than average (Mayo Clinic, 2019). Past work has also found that many individuals with depressive symptoms show slowed time awareness (Blewett, 1992). One of the most common symptoms in depressed and anxious individuals is feeling sad or down; given that, their mood is subject to change at any given time. As aforementioned, negative emotions are linked to the perceived slowing down of time (Droit-

Volet, 2013). Thus, these symptoms may be a contributing factor to time distortion in individuals with depression and anxiety.

Confounds in the Study of Mental Health and Time Distortion

A challenge with studying the relationship between mental health disorders is the presence of multiple confounds. That is, the symptoms of mental health disorders are not the only contributing factors that can affect time distortion. Other factors can contribute to the way individuals with mental health disorders perceive time, for instance, psychiatric medications, age, and emotions.

Psychiatric Medications

Individuals who are prescribed medications for depression, anxiety, or any other mental disorder, are prone to face side effects. These can include but are not limited to headaches, insomnia, nausea, tiredness, increased blood pressure, and even dissociation, which is the distortion of time, space, and illusions (Cleveland Clinic, 2019). This has led to thousands of individuals being hospitalized due to the severe side effects of their medications (Nazario, 2022). There are different medications patients take when they seek treatment for disorders such as depression or anxiety disorder. Some examples include selective serotonin reuptake inhibitors (SSRIs), tricyclic antidepressants (TCAs), monoamine oxidase inhibitors (MAOIs), and non-competitive N-methyl-D-aspartate receptor antagonists (NMDA) (Cleveland Clinic, 2019).

Non-competitive NMDA consists of phencyclidine, ketamine, and related arylcyclohexylamines, among other chemicals (Domino, 1992), and is one of the most common antidepressants. Phencyclidine is a dissociative hallucinogenic drug that causes mind-altering effects. A dose too large can cause a dissociation of awareness, where an individual experiences a distortion of time (Domino, 1992). Thus, individuals taking this type of antidepressant are at risk

of experiencing dissociation due to their medications. Similar to antidepressants, individuals seeking medication to treat their anxiety are often prescribed benzodiazepines and beta-adrenergic blockers (Leonard, 2020). Although these medications might help a patient feel less anxious, they are mixed with chemicals (i.e., piperidine and cyclohexanone) that cause a dissociative state. As mentioned before, this state can distort the individual's perception of time. These chemicals are commonly seen to be incorporated into these medications; thus, determining whether it is the medication or the mental health disorder itself (or some combination of the two) that causes time distortion may be challenging.

Age

Age might also be a confounding variable in this area of research because, according to the Centers for Disease Control and Prevention (2020), younger individuals from ages 18-29 are the most depressed and anxious, making up 21.0% of patients, followed by those aged from 45-64 with 18.4% (Villarroel & Terlizzi, 2020). There is a lack of research on how age may affect the passage of time. In a study, Wittmann and Lehnhoff (2005) asked their participants to fill out questionnaires and include their ages to analyze the perception of the passage of time. According to their study, the results concluded that the passage of time tends to speed up with age. Sensitivity to time has been observed to increase with age (Droit-Volet et al., 2007). When applying the Scalar Expectancy Theory, results suggest that children have more difficulty maintaining the switch closed during the timing of visual signals (Droit-Volet et al., 2007). Individuals may experience time distortion at different stages in their life; therefore, it might become different to measure it when focusing on a certain population or age group. Due to age being a potential confounding variable, research ought to include participants of varying ages.

Emotions

It has been proposed that emotions play an importance in how individuals perceive time. Common related phrases in the English language are "time flies when one is having fun" and "time drags when one is bored." However, due to the lack of research in this study, researchers have trouble explaining how these distortions of time account for accurate time measurement (Droit-Volet, 2013). Out of the primary emotions, such as fear, anger, sadness, disgust, happiness, and surprise, fear is the emotion that has been studied the most in research (Droit-Volet, 2013). Fear refers to the psychological and behavioral responses to threatening environmental situations. Past research has suggested that the internal clock system speeds up when the perception of a threatening signal occurs (Droit-Volet, 2013). This occurs because when an individual becomes threatened, the individual experiences trigger defense mechanisms. The body goes into a stress response, where a state of alarm triggers changes in the somatic and automatic nervous system, preparing the individual to act quickly (i.e., fight-or-flight response) (Droit-Volet, 2013).

Other negative emotions, such as sadness, shame, and disgust, have also been studied. According to Droit-Volet (2013), sadness is associated with energy loss and is a poorly understood emotion. There is no clear function of this emotion as it often coexists with guilt and anger (Droit-Volet, 2013). Droit-Volet (2013) suggested that the feeling of a slowdown in time while in a state of sadness is difficult to link to a problem in time perception. However, when studying the different clock rates (acceleration or deceleration) in individuals with depression—the higher sadness scores resulted in a speed-up in the internal clock system. In other words, the effect of a mental health disorder (depression) linked with a negative emotion (sadness) estimated a deceleration in time (Droit-Volet, 2013). Additionally, another study by Guan and colleagues (2015) found that emotions influence time perception, although emotions are not necessarily the primary cause of

time distortion. Thus, research suggests that emotions are one of the contributing factors to altered time perception, although they are not necessarily the sole contributor to this phenomenon.

Goals and Hypothesis

The present study aimed to determine if there is a relationship between mental health disorder symptomologies, such as those associated with depression or anxiety, and time perception. Do individuals with depression and anxiety perceive time at a slower rate, a faster rate, or about the same as individuals who do not experience symptoms associated with mental health disorders? This study focused on depression and anxiety, as these are some of the most prevalent mental health disorders (World Health Organization, 2022). It was predicted that individuals who score higher on measures of depression and anxiety would perceive time to be slower than those who do not. This prediction was based on the finding that individuals with depression and anxiety tend to experience more negative emotions rather than positive ones (Mayo Clinic, 2018), and as stated before, negative emotions often are associated with the perceived slowing down of time (Blewett, 1992).

Given this goal, the following hypotheses were advanced:

H_1: Mental health disorder symptomology will be associated with time distortion. Specifically, individuals who report higher levels of depression and anxiety will experience a slowing down of time.

H_2: Negative emotions will mediate the relationship between mental health disorder symptomology and time distortion. Individuals with higher levels of mental health disorder symptomology will experience more negative emotions, which, in turn, will lead to a perceived slowing down of time.

Thus, the following mediation model is proposed:

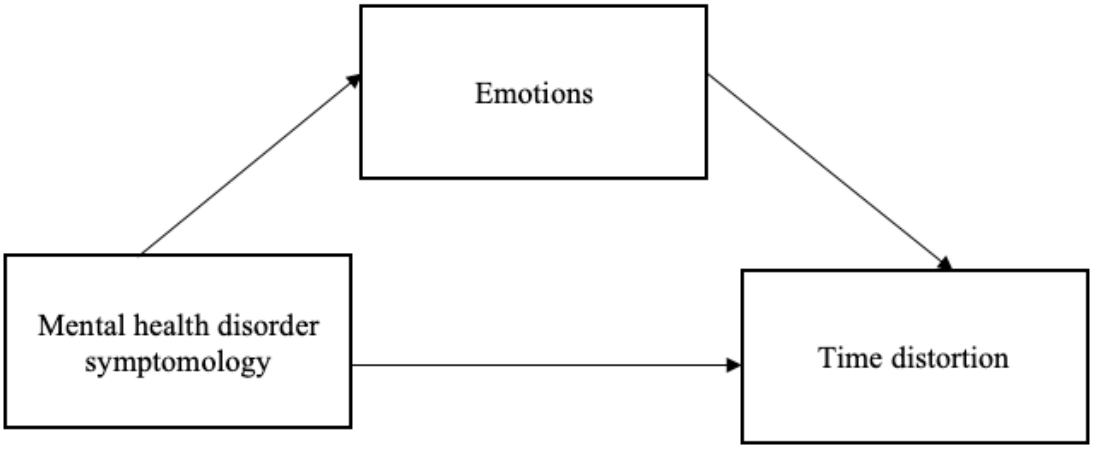


Figure 4: Proposed Mediation Model

METHODS

Participants

One hundred and ninety-eight participants were recruited from the research participation system, SONA, at the University of Central Florida (UCF), which primarily consists of undergraduate students. Five participants were excluded for failing to complete the entire survey, bringing the total sample size to $N = 193$. Participants partook in the study in exchange for course credit. The university's Institutional Review Board (IRB) reviewed and approved the study (see Appendix A).

Demographics

Age, gender, and race were collected for demographics (see Appendix B). Participants had an average age of 20.47 years (SD = 6.14). The ages ranged from 18 years to 65 years. Regarding gender, 29.0% identified as male, 66.8% as female, 2.1% as non-binary/third gender, 1.6% selected more than one gender, and 0.5% preferred not to say. As far as race, 49.7% reported to be White/Caucasian, 10.4% as Black/African American, 17.1% as Hispanic, Latino, or of Spanish Origin, 9.8% as Asian, 12.4% as Other/Mixed Race, and 0.5% preferred not to say.

Study Design

The present study proposed a mediation model in which negative emotions mediated the hypothesized relationship between mental health disorder symptomology and time distortion. Mental health disorder was the primary predictor variable, negative emotion was the mediating variable, and time distortion was the outcome variable. Two mental health disorders were examined: depression and anxiety. Thus, two mediation models were tested, one for each disorder.

Materials

Mental Health Symptomology

The Patient Health Questionnaire (PHQ-9) (Kroenke & Spitzer, 2002) (see Appendix C) was used to measure depression symptomology. Participants were asked to indicate how often in the last two weeks they had been bothered by typical depression symptoms (e.g., "little interest or pleasure in doing things." The PHQ-9 contains nine items, and participants respond to the items on a 4-point Likert Scale ("Not at all"- "Nearly every day"). This measure was scored by summing the participant's response on each of the nine items. Higher scores reflect greater levels of depression than lower scores. The General Anxiety Disorder (GAD-7) (Spitzer et al., 2006) (see Appendix D) was used to measure anxiety symptomology. Participants are asked to indicate how often in the past two weeks they had been bothered by typical anxiety symptoms (e.g., "feeling nervous, anxious, or on edge"). The GAD-7 contains seven items, and participants respond to the items on a 4-point Likert Scale ("Not at all"- "Nearly every day"). Like with the PHQ-9, the GAD-7 is scored by summing the participant's response to each item. Higher scores reflect greater anxiety symptomology than lower scores. In the present study, the measures proved sufficiently reliable: PHQ-9 ($\alpha = .90$) and GAD-7 ($\alpha = .91$).

Emotions

The Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988) was used to assess participant emotions (see Appendix E). The PANAS contained separate subscales for both positive (PANAS-PA) and negative emotions (PANAS-NA), although only the PANAS-NA was used in the mediation models. The PANAS contains two 10-item scales which measure both positive and negative affect on a 5-point Likert Scale ("Very slightly or not at all" – "A little"). Participants were asked to indicate both their positive and negative emotions during the past two weeks. The subscales were scored by summing the participant's response on each of the ten items. Lower scores represent lower levels of positive and negative affect, while higher scores represent

higher levels of positive and negative affect. Both the PANAS-PA (α = .91) and PANAS-NA (α = .89) were found to be reliable in the present study.

Time Distortion Survey

The primary dependent variable was time distortion. Participants completed a single-item measure of time distortion (see Appendix F). The purpose of this item was to collect details on the degree to which participants recently experienced time distortion. A sliding scale was used, which allowed the participants to select an answer between 0 and 100. A score of 50 reflected no time distortion, a score of 100 reflected that time seemed to speed up, and a score of 0 reflected that time seemed to slow down.

Procedure

Participants enrolled in the study through UCF's online research participation system (SONA). Participants had no time limit to complete the survey, as they had the opportunity to express their thoughts to the best of their ability. The survey was conducted online, and participants had the flexibility to choose where they felt most comfortable completing the survey. After accessing the study through Qualtrics, an online survey platform, participants first completed the PHQ-9 and GAD-7. Next, participants completed the PANAS, followed by the time distortion items. Participants then responded to various demographic items, including age, gender, and race. At the end of the survey, the participants were thanked for their time and contribution to the study.

RESULTS

Method of Analysis

For this study, the data were analyzed using the statistical software platform SPSS (IBM, 2022). The primary method of analysis was mediation analysis using Haye's PROCESS macro for SPSS, more specifically, the Mediation Model 4 (Hayes, 2018). The bootstrap confidence intervals were computed for the direct and indirect effects using 5,000 bootstrap samples. The statistical assumptions of linearity, normality, and homoscedasticity were checked, mediation was checked, and no assumptions were violated in the present study.

Descriptive Statistics and Correlations of Study Variables

Prior to conducting mediation analysis, the descriptive statistics and correlations between study variables were examined and are presented in Table 1. Most participants seemed to score in the mid-range of scores on the PANAS-PA (M = 28.42, SD = 8.61) and PANAS-NA (M = 22.05, SD = 8.09). The scores for the anxiety (M = 6.88, SD = 5.64) and depression (M = 8.51, SD = 6.32) variables are classified as moderate depression and mild anxiety according to the scale authors (Kroenke & Spitzer, 2002; Spitzer et al., 2006). The average time perception score was 60.94 (SD = 22.86), indicating that participants tended to experience time to move faster than slower. Although there was a significant correlation between mental health symptomologies and negative emotions, there was no significant correlation between negative emotions and time perception or positive emotions and time perception.

Table 1

Descriptive Statistics and Correlations for Study Variables

Study Variable	*N*	*M*	*SD*	1	2	3	4	5
1. Positive Affect	191	28.42	8.61	—				
2. Negative Affect	192	22.05	8.09	-.18*	—			
3. Depression [a]	193	8.51	6.32	-.37**	.70**	—		
4. Anxiety [b]	193	6.88	5.64	-.22**	.74**	.77**	—	
5. Time perception [c]	192	60.94	22.86	.13	-.05	-.07	-.07	—

[a] Depression was measured using the PHQ-9. Higher scores reflect greater levels of depression.

[b] Anxiety was measured using the GAD-7. Higher scores reflect greater levels of anxiety.

[c] Refers to the sliding scale measure of time distortion: "Over the past two weeks, in general, how fast or slow did time seem to pass?" Higher scores reflect time passing faster than normal, and lower scores reflect time passing slower than normal.

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

Mediation Analysis 1

First, the hypothesized relationship between depression and perceived time as mediated by negative emotions was examined. The total effect of depression on perceived time was not statistically significant, $R = .07$, $R^2 = .01$, $F(1, 189) = 1.00$, $p = .320$, $b_{Depres} = -.26$, $SE_b = .26$, $t(190) = -1.00$, $p = .320$, $CI_{Bootstrap}$: [-.77, .25]. The mediation analysis indicated that the direct effect of depression on perceived time was also not significant, $b_{Depres} = -.28$, $SE_b = .36$, $t(190) = -0.77$, $p = .440$, $CI_{Bootstrap}$: [-.99, .44]. The total indirect effects (i.e., the product of the two indirect pathways) were not significant, $b = .20$, $CI_{Bootstrap}$: [-.60, .60]. Although higher levels of depression were

significantly related to higher negative affect scores (b = .89, p < .001), negative affect did not significantly relate to perceived time (b = .02, p = .922).

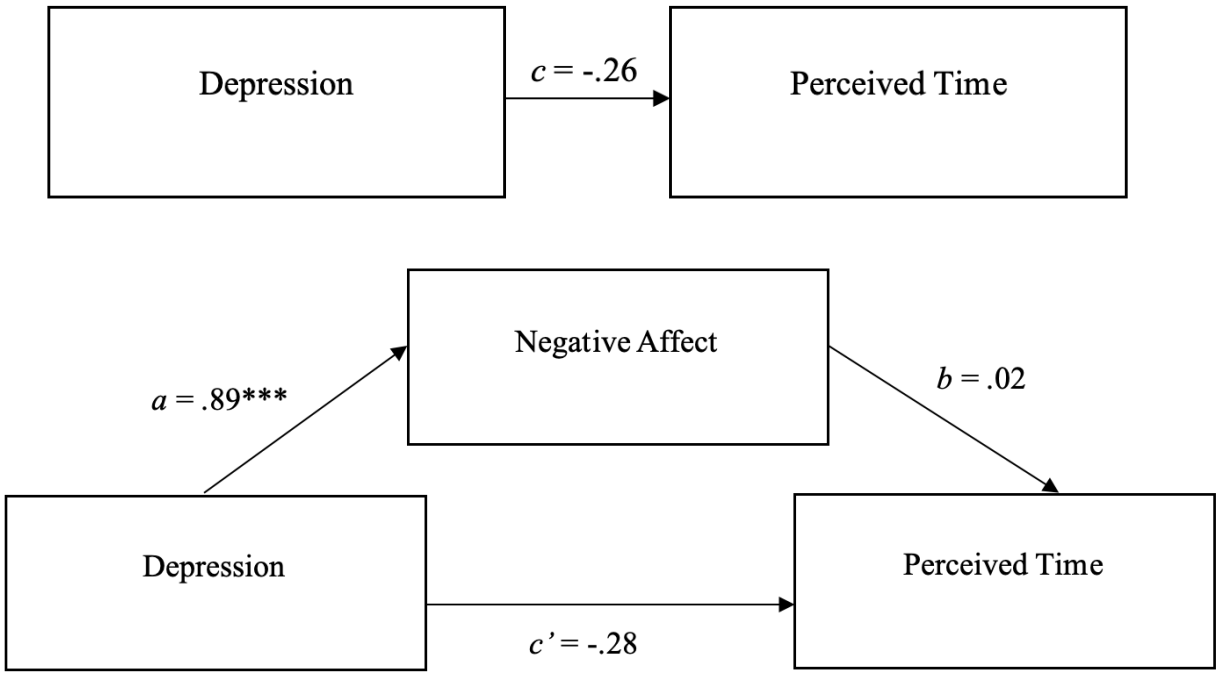


Figure 5: Path Diagrams for the Relationship between Depression and Perceived Time, as Mediated by Negative Affect

Note. c = total effect of depression on perceived time; c' = direct effect of depression on perceived time; a and b = indirect pathways.

***p < .001.

Mediation Analysis 2

Next, the hypothesized relationship between anxiety and perceived time, as mediated by negative emotion was examined. The total effect of anxiety on perceived time was not statistically significant, R = .07, R^2 = .01, F(1, 189) = 0.99, p = .322 , b_{Anx} = -.28 , SE_b = .29, t(190) = -0.99, p = .322, $CI_{Bootstrap}$:[-.89, .29]. The mediation analysis indicated that the direct effect of anxiety on perceived time was also not significant, b_{Anx} = -.33, SE_b = .43, t(190) = -0.77, p = .438, $CI_{Bootstrap}$:

[-1.18, .51]. The total indirect effects (i.e., the product of the two indirect pathways) were not significant, b = 0.44, $CI_{Bootstrap}$: [-.67, .68]. Although higher levels of anxiety were significantly related to higher negative affect scores (b = 1.05, p < .001), negative affect did not significantly relate to perceived time (b = .04, p = .889).

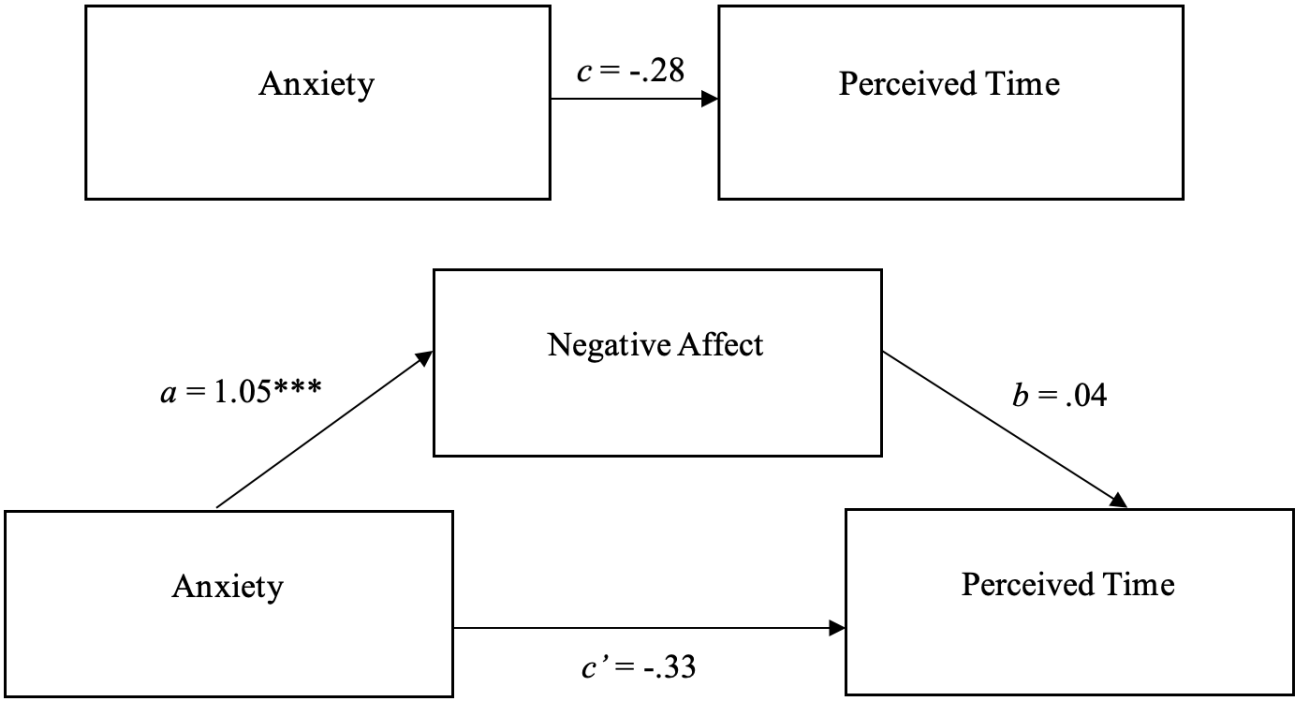


Figure 6: Path Diagrams for the Relationship between Anxiety and Perceived Time, as Mediated by Negative Affect

Note. c = total effect of anxiety on perceived time; c' = direct effect of anxiety on perceived time; a and b = indirect pathways.

***p < .001.

DISCUSSION

The present study aimed to determine if there was a relationship between mental health disorder symptomologies and time perception and whether negative emotions mediated this relationship. The present study focused on two mental health disorders—anxiety and depression. The first hypothesis predicted that individuals with higher levels of mental health disorder symptomology would experience a slowing down of time. Based on the results of the study, the hypothesis was not supported because there was no significant total effect of depression on perceived time, nor was there a significant total effect of anxiety on perceived time. The second hypothesis predicted that negative emotions would mediate the relationship between mental health disorder symptomology and time distortion. Specifically, mental health disorders would be associated with higher levels of negative emotions, which, in turn, would be associated with a greater perceived slowing down of time. The hypothesis was not supported either, as negative emotions did not mediate the relationships between anxiety and depression and time perception.

The time distortion slider scores indicated that participants felt like time had sped up during the past two weeks. One reason for this might be because of the COVID-19 pandemic. The COVID-19 pandemic first originated in Wuhan, China, in late 2019 (Centers for Disease Control and Prevention, 2022). In 2020, it was declared a global pandemic that caused nearly the whole world to shut down by creating nightly curfews and creating travel restrictions. This was a time when many individuals lost their jobs and spent more time at home. According to a research study that analyzed the perception of time during the COVID-19 pandemic, half of the sample felt like time was speeding up, whereas the other half claimed it seemed to be slowing down (Holman et al., 2022). Due to the pandemic being such a recent event with lasting effects, this might have

affected the perception of time for the participants above and beyond any effect of mental health disorder symptomology and negative emotion.

Moreover, the single-item time distortion measure might not have been sensitive enough to capture any perceived time distortion. The slider question did not allow the participants to indicate any time distortion outside the past two weeks, limiting the present study's ability to capture experiences of time distortion. Additionally, participants might not accurately remember how time felt in the past two weeks, resulting in biased results that would not accurately capture time perception. Another factor that might have impacted the results was the fact that participants might have also felt both a speed-up and a slow-down in time, as they were not given a way to indicate this during the survey.

In the present study, there was no association between time perception and emotions. Nevertheless, prior research suggests that depending on the state of our emotions, our sense of time is altered (Droit-Volet & Meck, 2007). When one is having fun, time tends to be perceived as being faster. Positive emotions are often linked with a speed-up in time because positive emotions, such as happiness and excitement, are associated with dopamine releases, which cause the internal clock to create a sense of speeding time (Simen & Matell, 2016). Dopamine is known as the hormone that is released through one's blood when associating a specific activity with pleasure (Pietrangelo, 2019). Other research supports the idea that negative emotions are linked to a slow-down in time (Droit-Volet, 2013). This can be explained by the lack of dopamine released when experiencing negative emotions, such as sadness and worry. Nonetheless, this effect was not found in the present study. Potential reasons for this deviation from past research are discussed below.

Limitations

Single-item Measure

As previously mentioned, the single-item measure of time distortion was one of the greatest limitations in this study as it was the only question in the survey that focused on time distortion. The measure also only allowed participants to select a single number between 0 and 100, so participants could not provide an accurate response if they had experienced both a slowdown and speed-up of time. Additionally, the slider item focused on a time period of the past two weeks, preventing participants from including any temporal distortion that fell outside that window.

Demographics

Most of the participants in the study were relatively young, White, and female. Research suggests that as an individual ages, the passage of time also increases (Wittmann & Lehnhoff, 2005). The average age of the participants conducted in this study was 20.47, representing the average college student's age. Despite the relatively young sample in the present study, time was reported as speeding up. Because the survey was only released on SONA, it limited the responses from other age groups; therefore, the results of the present study may be unrepresentative of the entire population and may not generalize to other age groups. Furthermore, the vast majority of the participants were White and female. Although the relationship between gender, race, and time perception remains relatively unexplored, it is possible that the demographic makeup of the present study may have impacted the results and limited the generalizability of the study.

Survey Length

The length of the survey might have diminished the ability for participants to respond accurately due to a longer survey and biased results. Although the survey did not take participants too long to complete, the number of questions asked might have limited the accuracy of the study. Research suggests that shorter questionnaires receive a significantly increased response rather than

lengthy questionnaires (Sahlqvist et al., 2011). It is often advisable to minimize the length of questionnaires to maximize the response rate and quality of the responses (Sahlqvist et al., 2011).

Psychiatric Medications

It is possible for psychiatric medications to impact the perception of time. Certain antidepressants, such as non-competitive N-methyl-D-aspartate receptor antagonists (NMDA), are known to have chemicals that cause dissociative states (Domino, 1992). These states can then alter an individual's passage of time and typically lead to a reduction of time (Allman & Meck, 2012). Thus, it is plausible that participants' medication may have impacted the results. However, asking if a participant was taking medications was avoided in the study as it poses ethical concerns.

Directions for Future Research

The relationship between mental health disorders and time perception is a topic that ought to be further investigated. While the results of this thesis do not demonstrate a relationship between these variables, future research is crucial to further understand how individuals with mental health disorders perceive time. Upon reflection on the present study's limitations, adding more measures of time distortion is a crucial next step in this research. Moreover, greater diversity in both gender and race may lead to results that more accurately reflect the experiences of the general population.

Although this study only focused on analyzing the two most common mental health disorders, depression and anxiety, future studies should consider studying other disorders, such as Parkinson's Disease, Autism Spectrum Disorder, and Attention-Deficit/Hyperactivity Disorder (ADHD) (Allman & Meck, 2011). It would be particularly interesting to analyze the effect psychiatric medications have on other mental health disorders in a more in-depth study. Individuals who suffer from one or more severe mental health disorders seem more prone to be prescribed psychiatric drugs to help with their disorder, and this might lead to a large effect on the passage of

time. For example, individuals who suffer from ADHD are normally given medication to help treat it, amphetamine being one of the stimulant medications (Newman, 2017). Although this prescribed medication might help these individuals, they are also at risk of experiencing an impacted and distorted perception of reality (Wadler, 2021). Thus, this line of research might help explore the relationship between mental health disorders, psychiatric medications, and time perception.

Conclusions

The purpose of this study was to evaluate the proposition that mental health disorders and emotions are related to time perception. Although this thesis did not find an effect of mental health symptomology, emotions, and time perception, past research (i.e., Gil & Droit-Volet, 2009; Dawson & Sleek, 2018) suggests individuals with mental health disorders tend to experience a slowdown of time. More importantly, negative emotions also affect the perceived passage of time by slowing it down (i.e., Droit-Volet, 2013). However, the present study failed to find evidence for this effect. Future research should consider looking at a wider age range to provide more accurate results in the study. Additionally, future researchers should consider studying time distortion as a whole rather than during a brief moment in time.

Investigating the impact that mental health disorders have on perceptual experiences is crucial for understanding those who suffer from these disorders. Due to the large gap in the literature and the phenomenological experience of time, the effect that mental health disorders have on time perception is challenging to understand. However, research on this topic is critical for developing ways to treat and prevent any unwanted temporal distortions. The present study and discussed avenues for future research pave the way to better understand how mental health disorders impact time perception.

APPENDIX A: IRB APPROVAL LETTER

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

EXEMPTION DETERMINATION

September 13, 2022

Dear Peter Hancock:

On 9/13/2022, the IRB determined the following submission to be human subjects research that is exempt from regulation:

Type of Review:	Initial Study
Title:	Time Perception and Mental Health
Investigator:	Peter Hancock
IRB ID:	STUDY00004679
Funding:	None
Grant ID:	None
Documents Reviewed:	• Demographics.docx, Category: Survey / Questionnaire; • End of Survey Resources.docx, Category: Other; • General Anxiety Disorder.docx, Category: Survey / Questionnaire; • IRB Hancock 4679 HRP-254 Explanation of Research.pdf, Category: Consent Form; • IRB Hancock 4679 HRP-255 Request for Exemption.docx, Category: IRB Protocol; • Patient Health Questionnaire.docx, Category: Survey / Questionnaire; • Positive and Negative Affect Schedule.docx, Category: Survey / Questionnaire; • Time Distortion Survey.docx, Category: Survey / Questionnaire;

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please submit a modification request to the IRB. Guidance on submitting Modifications and Administrative Check-in are detailed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Kamille C. Birkbeck

Kamille Birkbeck
Designated Reviewer

APPENDIX B: DEMOGRAPHICS

What is your age in years?

_____

Which of the following best describes your gender identity?

- Male
- Female
- Non-binary / third gender
- Other (feel free to specify)
- Prefer not to say

Which of the following best describes your racial identity/ethnicity? Select all that apply.

- White/Caucasian
- Black or African American
- Hispanic, Latino, or of Spanish origin
- American Indian or Alaska Native
- Native Hawaiian or Pacific Islander
- Asian
- Other (feel free to specify) _____
- Prefer not to say

APPENIDX C: PATIENT HEALTH QUESTIONNAIRE (PHQ-9)

Instructions: Over the last 2 weeks, how often have you been bothered by any of the following problems? Please circle your answers.

PHQ-9	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
Little interest or pleasure in doing things.	0	1	2	3
Feeling down, depressed, or hopeless.	0	1	2	3
Trouble falling or staying asleep, or sleeping too much.	0	1	2	3
Feeling tired or having little energy.	0	1	2	3
Poor appetite or overeating.	0	1	2	3
Feeling bad about yourself – or that you are a failure or have let yourself or your family down.	0	1	2	3
Trouble concentrating on things, such as reading the newspaper or watching television.	0	1	2	3
Moving or speaking so slowly that other people could have noticed. Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual.	0	1	2	3
Thoughts that you would be better off dead, or of hurting yourself in some way.	0	1	2	3

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people? (Check One)

Not difficult at all **Somewhat difficult** **Very difficult** **Extremely difficult**

APPENDIX D: GENERAL ANXIETY DISORDER (GAD-7)

Instructions: Over the last 2 weeks, how often have you been bothered by any of the following problems? Please circle your answers.

GAD-7	**Not at all**	**Several days**	**Over half the days**	**Nearly every day**
Feeling nervous, anxious, or on edge.	0	1	2	3
Not being able to stop or control worrying.	0	1	2	3
Worrying too much about different things.	0	1	2	3
Trouble relaxing.	0	1	2	3
Being so restless that it's hard to sit still.	0	1	2	3
Becoming easily annoyed or irritable.	0	1	2	3
Feeling afraid as if something awful might happen.	0	1	2	3

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people? (Check one)

Not difficult at all **Somewhat difficult** **Very difficult** **Extremely difficult**

APPENDIX E: POSITIVE AND NEGATIVE AFFECT SCHEDULE (PANAS)

Instructions: Indicate the extent you have felt this way over the past two weeks, including today.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	□	□	□	□	□
Distressed	□	□	□	□	□
Excited	□	□	□	□	□
Upset	□	□	□	□	□
Strong	□	□	□	□	□
Guilty	□	□	□	□	□
Scared	□	□	□	□	□
Hostile	□	□	□	□	□
Enthusiastic	□	□	□	□	□
Proud	□	□	□	□	□
Irritable	□	□	□	□	□
Alert	□	□	□	□	□
Ashamed	□	□	□	□	□
Inspired	□	□	□	□	□
Nervous	□	□	□	□	□
Determined	□	□	□	□	□
Attentive	□	□	□	□	□
Jittery	□	□	□	□	□
Active	□	□	□	□	□
Afraid	□	□	□	□	□

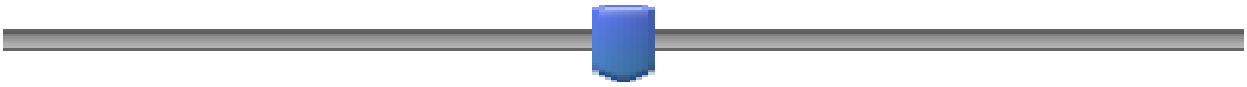
APPENDIX F: TIME DISTORTION SURVEY

Instructions: Please respond to the following items about your experience of time. All items pertain to the past two weeks, including today.

1. Over the past two weeks, in general, how fast or slow did time seem to pass? Please move the slider to indicate your response.

Time seemed to slow down (i.e., time felt as if it was moving slower than it normally does).	Time did not change (i.e., time felt as if it was moving the same as it normally does).	Time seemed to speed up (i.e., time felt as if it was moving faster than it normally does).

0 50 100



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